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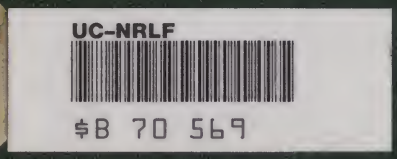
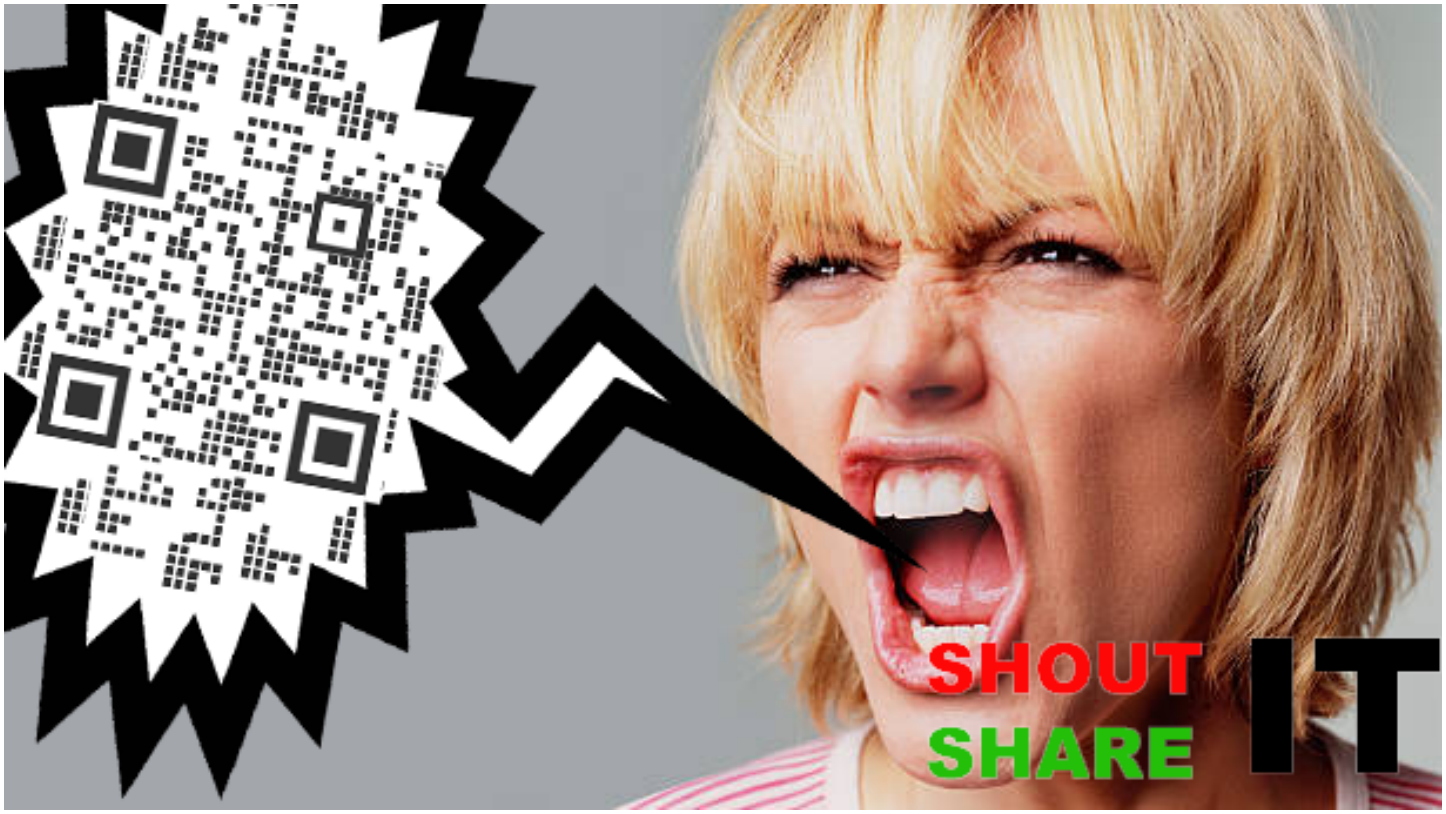


GRASSES

AND

FORAGE PLANTS

KILLEBREW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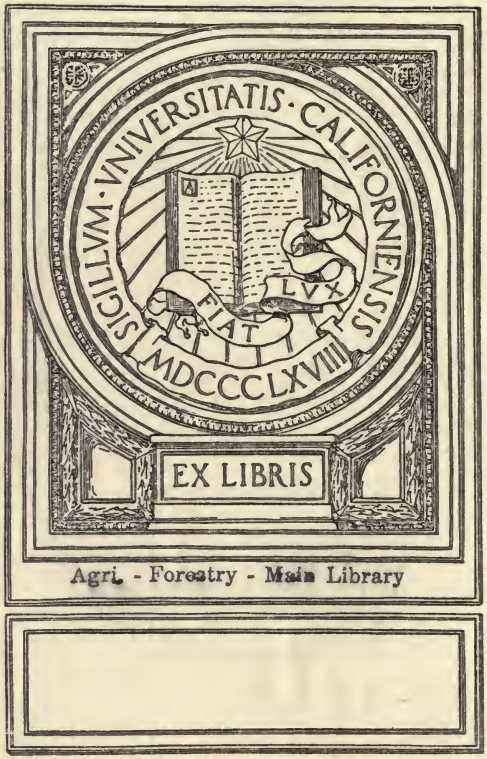

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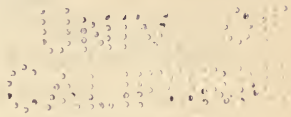

—BY—

J. B. KILLEBREW, A.M., Ph.D.

BULLETIN OF THE
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THE AGRICULTURAL EXPERIMENT STATION

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Knoxville, Tennessee.

☞The Experiment Station building, containing its offices, laboratories and museum, and the plant house and horticultural department, are located on the University grounds, fifteen minutes walk from the Custom House in Knoxville. The Experiment farm, dairy barn, stables, milk laboratory, etc., are located one mile west of the University, on the Kingston pike. Farmers are cordially invited to visit the buildings and experimental grounds.

Bulletins of this Station will be sent, upon application, free of charge, to any Farmer in the State.

NOTE.

The Tennessee Experiment Station published, in 1892 and 1894, two bulletins on The Grasses of Tennessee, from the pen of Prof. F. Lamson-Scribner, at that time Botanist of the Station, now Agrostologist of the United States Department of Agriculture. Part I. of this work was a handy reference book of information as to the general character and quality of our grasses; Part II. was a handbook of the grasses of the State, with full descriptions and illustrations.

The present publication is the first of a series of bulletins which will discuss the methods of cultivating and using the domesticated grasses and forage plants of Tennessee, of establishing and maintaining permanent meadows and of harvesting and using the various kinds of forage. It is designed thus to complete the former series.

The Station has been fortunate in securing, to prepare this new series, the services of Col. J. B. Killebrew, A. M., Ph. D., probably the greatest authority in the South upon the culture and uses of grasses and forage plants, whose work on the grasses and forage plants of Tennessee, published in 1878, now entirely out of print, remained until the present time the best manual on the subject. The present work gives the result of twenty years' additional study and experience in the cultivation of grasses and forage plants.

The analytical engravings of grasses in this Bulletin were made by Prof. F. Lamson-Scribner. A few of the larger cuts are from Scribner's translation of Haeckel's "True Grasses." The half tone engravings are from Tennessee and Southern sources.

CHAS. W. DABNEY, President.

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GRASS GARDEN AT THE TENNESSEE EXPERIMENT STATION.

PREFACE.

This is a practical work on grasses, prepared by a practical man, for practical farmers. The basis of the work is the author's experience on his own farm, supplemented by his observations of the making of meadows and pastures in nearly every state and territory in the Union. This experience and these observations have been fortified by a diligent study of the literature on grasses in this country, and from Great Britain as well.

Among the works, which have afforded him the greatest aid are the bulletins issued by the United States Department of Agriculture, and by the various experiment stations. He is especially indebted to F. Lamson-Scribner, probably the most accomplished agrostologist in America, for many years botanist of the Tennessee station, now of the United States Department of Agriculture. The works of Rev. C. W. Howard, of Georgia; of Dr. Phares, of Mississippi; of Dr. Gattinger, of Tennessee; of Prof. J. Stanton Gould, of New York; of Prof. C. L. Flint, of Massachusetts; of Prof. Beal, of Michigan; of Edmund Murphy, of Ireland and Margaret Flues, of England, have been freely consulted, and to all of them the writer acknowledges his indebtedness for valuable, practical suggestions. In addition to these the agricultural reports of the various states have been consulted. The old files of the "Rural Sun" contain many admirable articles on the grasses, and these have been frequently used.

The author hopes that this work will meet the demands of many farmers of Tennessee, who are anxious to enter more extensively upon the cultivation of the grasses, and that it will supplement the excellent scientific work already done by our Experiment Station to the great benefit of agriculture in Tennessee.

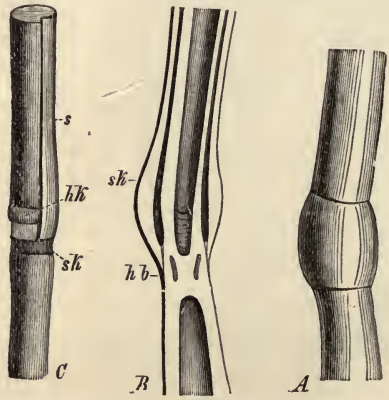
J. B. KILLEBREW.

GRASSES AND FORAGE PLANTS.

INTRODUCTION.

No vegetable products of the soil are of such transcendent importance to mankind as are the grasses. Included in the family of grasses are all the cereals that furnish the important bread-grains upon which the largest number of the population of the globe subsists. The animals, domestic and wild, that furnish meat for the sustenance of the most civilized portion of the human family feed upon grasses. Indeed it is difficult to see how the people of our planet could survive the entire destruction of the grass family.

The vast importance of grasses in the creation of wealth is difficult to estimate. The annual production of hay in the United States according to the eleventh census was 66,831,480 tons, grown on 52,948,797 acres.

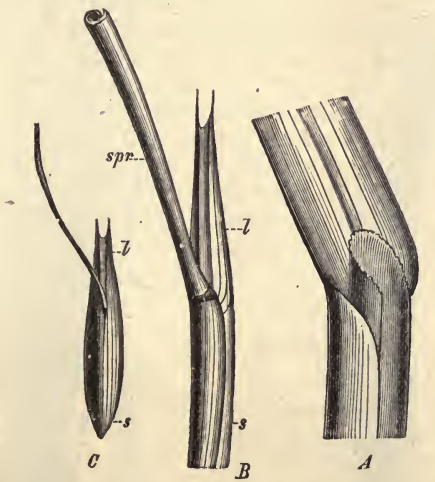


A. Fragment of culm of wheat with sheath-node, somewhat bent. B. Longitudinal section of the same; sk, sheath-node; hb, point of insertion of the sheath. C. *Andropogon;* the sheath is removed on the left side in order to show the culm-node, hk; sk, sheath-node.

having a farm value, taking the average of four years, of $514,602,096. There is no crop that surpasses the hay crop in value. The corn crop, one year with another, runs nearly equal in value. The wheat crop follows with an annual value for a full crop of $425,000,000. This is followed by the cotton crop, the value of which rarely exceeds $300,000,000. But in this estimate of the value of grass to the country no account has been taken of the value of pastures. In area, the pasture grasses occupy at least two acres to one of meadow grasses, and the value of their annual production cannot be less than that of the meadows. This will make the total approximate value of the grass crop $1,029,204,792. The making of

"two blades of grass to grow where only one grew before" is the most certain road to wealth and commercial supremacy. But even corn and wheat are the matured fruit of the grasses, as well as oats, rye, barley, rice and nearly all other bread-grains that enter into the commerce of the country. Exclude the grasses from agriculture and the value of farm products would be reduced fully five-sixths.

HOW TO TELL A GRASS.—At the very outset several important questions likely to be asked by the unscientific farmer, should be answered. How shall I tell a grass? What are its most distinguishing characteristics? How shall I separate it from other forms in the vegetable kingdom? Without attempting to instruct such a farmer in the science of botany a few elementary principles may be laid down, which will aid him in determining a grass from other lowly forms of vegetable life and may lead him to a more extensive study in this delightful field of inquiry.



Point of separation of the sheath (s) and blade (spr). A. In *Dactylis glomerata* L. B. In *Ammophila arundinacea* Host. l. Ligule. C. Flowering glume of *Bromus Alopecurus* Poir.

1—A true grass, with rare exceptions, has either a hollow stem; or it is filled with pith, like Indian corn or broom grass, commonly called "broom sedge."

2—A cross section of the stem is circular or elliptical, but generally round.

3—The stem or stalk or culm of a grass is divided into sections and the continuity of the hollow in the stalk is broken by cross partitions. These partitions are located at the *nodes*. The parts of the stalk between the nodes are called joints or internodes. In other words the stalk or culm is separated like pipe stems or fishing poles by the intervention at intervals of a solid partition, which partition closes the tube.

4—The leaves of grasses are always alternate, that is, only one at a joint. The leaves have a sheath that encloses the stem, but this sheath

is never a solid cylinder. It is split or open on the side opposite the leaf. The blade of the leaf is narrow, and its nerves or veins are parallel to each other, forming raised ribs on the underside that run the whole length of the leaf. In grasses the third leaf overhangs the first and the fourth overhangs the second. In sedges the fourth leaf will stand over the first and the fifth over the second. This is an easy way of distinguishing a grass from a grass-like sedge. Another important thing to remember is that sedges always have closed sheaths.

Rye. *Barley.*

Two useful plants in the family of grasses.

PART I.

DOMESTICATED GRASSES.

Between the Mississippi River and Atlantic ocean there are known to exist about 295 species of grasses indigenous to the soil. Between the Mississippi River and the Rocky Mountains there are 190 species, 60 species belonging to that region exclusively. This makes a total of 355 species of grasses from the Rocky Mountains to the Atlantic ocean. There are 250 that have been found between the Pacific ocean and the Rocky Mountains, many of which are common to the other sections of country. It may, with confidence, be said that there are not less than 350 grasses indigenous to the United States. Nearly one-half of these are found within the State of Tennessee. Many have been introduced and are cultivated in every part of the state, and some of the indigenous grasses also have been domesticated. A considerable percentage of them are valuable for making pastures and meadows but others are unmitigated pests and worthless for any purpose whatever.

Out of all this number of grasses, 29 have been selected for discussion in detail in this bulletin. The grasses selected have, in nearly every instance, been tested not only in the various experiment stations in the south and especially at our Experiment Station at Knoxville, but they have been successfully grown by the farmers of the state. A few grasses have been mentioned, not for the purpose of recommending them for cultivation, but to warn the farmers of the state against them.

Timothy—Phleum pratense.

1. The base of plant. 2. Inflorescence. 3. Empty glumes. 4. Floret.

TIMOTHY — (*Phleum pratense.*)— (Meadow Grass.)

Named for Timothy Hansen, of North Carolina, who introduced it into this country from England in 1720. Timothy has become the most popular, the best known and the most profitable hay grass in the United States. This popularity is due not altogether to its superiority in nutritive elements, but largely also to the fact that it makes the standard hay of commerce, with which all other kinds are compared. It is sold in all the markets of the country, and its price is quoted in all the leading commercial journals. In buying this hay therefore, one knows precisely what he is paying for. He knows how much to feed

and what result to expect from it. It is graded like cotton, tobacco and wheat, and it is the only hay that is in universal demand. For this reason, more than for any other, it is the most profitable, because the sale of it is most certain.

SOILS—Timothy is a perennial grass and grows best upon a moist, tenacious, rich soil. It does not thrive on high, dry or sandy lands, however fertile they may be. The best situation is valley land having a soil rich in calcareous matter and humus, not too loose or friable but with a sufficiency of clay in its composition to make it reasonably compact. Timothy starts slowly in the spring and it does not take so rank a hold upon the soil as many other meadow grasses do. It is not suited for pasturage, for it has but little aftermath and the tramping of stock soon destroys it.

In Tennessee the best lands for its growth are found in the valley of East Tennessee upon calcareous soils, in the Central limestone basin of Middle Tennessee, and in the northern and western counties of West Tennessee. Many of the bottom lands on the Cumberland River and its tributaries are eminently adapted to its growth. It is unfitted generally for the dry and cherty lands of the Highland Rim. The conditions favorable for its growth, however, may be found in the elevated basins of Montgomery, Robertson and Stewart counties, as well as those in Franklin, Warren and other counties lying at the western base of the Cumberland Mountains where the soils have a large content of the carbonate of lime. On all the bottom lands lying on the streams of those counties suitable soils are found, except where there is a predominance of sand and gravel. Many of the bottoms lying on little Tennessee River in East Tennessee and on Pigeon River are admirably adapted to the growth of timothy. Powell's Valley, in Claiborne county, furnishes soils capable of growing very large crops. The writer has seen magnificent timothy meadows in the elevated coves near the top of the Unaka mountains in Johnson and Carter counties, where mists and rains are almost of daily occurrence in summer. In general it may be said that the conditions most favorable for the growing of timothy hay are: (1) A rich, tenacious, calcareous soil with some humus; (2) a situation where moisture is retained in the soil throughout the growing season, but in connection with good drainage.

PREPARATION—After the selection of a suitable soil and situation for the growth of timothy, the land should be well and thoroughly broken. The depth of the plowing must be regulated by the depth of the soil. On deep, rich, alluvial bottoms the deeper the land is plowed the better. Care, however, must be taken in preparing thin soils not to throw too much clay to the surface, for this will impair the fertility of the seed bed and prevent the young plants from attaining a vigorous vitality. When the soil has been well broken, and repeatedly harrowed until it is thoroughly pulverized, it is in a condition to receive the seed. The best time for sowing this grass in Tennessee is the last week in September or the first week in October, after the dry hot weather has been tempered by cool nights, heavy dews and frequent rains. It is best not to sow the seed until the ground is moistened by rain, otherwise the heavy dews may

cause the seed to germinate when the hot suns of mid-day are likely to destroy the young plants.

The quantity of seed to be sown is regulated somewhat by the character of the soil. On rich, heavy, deep soils a third of a bushel to the acre will not be too much; on thin light soils, two gallons per acre will be ample. The seed may be sown with a drill and probably it will increase the future crop for the land to be afterwards rolled. The sowing may be done by hand, the width of the spaces sown being regulated by stakes. Eight feet is as wide a space as one should attempt to sow. It is best to sow the land with one-half of the seed and then cross-sow it. This will insure a more even distribution of the seed. After sowing a light drag brush or roller, or both, should be run over the land so as to slightly bury the seed and produce rapid germination. The drag brush used for this purpose should be light.

The best crop to precede timothy is tobacco, or some clean-hoed crop. The next best is a crop of millet or Hungarian grass sown in the summer and harvested in September. This leaves the land clean and free from any noxious vegetation. Many persons, after the removal of the millet, do not rebreak the land but harrow it well and immediately sow the timothy seed. With such preparation they claim they are able to secure a better stand than in any other manner. This result is no doubt largely dependent upon the character of the soil.

Timothy rarely does well when sown with wheat or rye in the fall, or with oats in the spring. The only reason assigned for thus sowing it is that it saves one preparation of the land, but in trying to economize in this work it often follows that the wheat crop is injured, while the timothy crop is put off one year and frequently completely fails. It is a most unusual thing to get a good stand of timothy when it is sown with grain; in thus sowing it there is great danger of entirely losing the seed or of having a meadow spotted with many vacant places.

Many excellent meadows are made by sowing with the timothy seed a gallon of herd's grass seed to the acre with a slight sprinkling of clover seed. One gallon of clover seed for ten acres will be sufficient. The hay thus mixed has more richness or nutriment, has a better flavor, is more relished by stock, and, indeed, is a complete food. At the same time the yield is greatly increased. The amount of clover will not be sufficiently large to impair the keeping qualities of the hay or to make it easily injured by dampness.

CUTTING AND CURING—The best time for cutting timothy to make the largest quantity of sweet hay is when it has stopped blooming and a few of the blooms begin to fall. The best cutting stage is limited, extending from the time when the first blooms begin to fall to the time when the first dry spot appears above the first joint and half the blossoms have turned brown. If mowed before the blooms begin to fall the vitality of the plant will be endangered. If mowed after the stalk has become hard, the hay is of but little value for the nourishment of animals. Cut at the right stage, every part of the plant is palatable to stock. The culm or stem, which forms such a large proportion of the whole at this period, is soft and tender and the blades are green and succulent through-

out. If the time of cutting is deferred until the seed begins to ripen many of the blades will be dry and the stalk will be yellow and hard for a considerable portion of its length. It will be woody, indigestible as food, and a great part of its value will be lost. When timothy is over-ripe it has very little more value than oat-straw for feeding. When cut in its prime it has no superior as a hay.

Timothy hay cures quickly. It should remain in the sun only long enough to assure it against mould. After it is well wilted it must be raked into wind-rows and afterwards made into small cocks four feet in diameter at the base and about five feet high, well pointed and rounded off at the top. Within a day or two, the hay will be cured sufficiently to put into permanent ricks or stacks, or to be stored in an open shed, from which it may be baled and sent to market. If a rain should unfortunately fall while the hay lies in wind-rows or in cocks, wetting it to a considerable depth, it must be immediately opened to the sunlight until it is dried out. It is best for the quality of the hay that not a single drop of rain fall upon it and that it be cured, as far as possible, with the least amount of sunshine. This method will make sweet, fragrant and nutritious hay of prime quality with excellent color.

When the saving of seed is the main object, timothy should not be cut until the heads are fully ripe. A good thick stand of timothy upon rich land should yield from eight to twelve bushels of seed to the acre, weighing 45 pounds to the bushel, which is the legal weight in Tennessee. Of timothy seeds there are about 75,000 in an ounce.

Heavy rains or strong winds are to be feared after the heads are fully ripe, for they beat out the seeds and largely diminish the yield. In cutting timothy for seed the self-binder should be used, and the grass tied up in bundles like wheat or oats, and put up in shocks where it must remain for two weeks or more, until it is dried thoroughly and is ready for the thresher. The fewer times the bundles are handled, after being fully dried, the less will be the loss of seed.

The yield of timothy hay on fertile valley lands sometimes reaches three or four tons an acre. It oftens attains a height of five feet with heads from eight inches to a foot in length. A bottom field lying on Red river in Montgomery county was sown by the writer in 1858 with a mixture of timothy and herd's-grass. It was sown the latter part of September. The following summer thirty tons of excellent hay was sold from ten acres and two or more tons were retained for home consumption. The soil of this meadow was a calcareous loam with a deep red, well-drained, unctious, clayey subsoil. The meadow lasted for twelve years and yielded heavy crops of hay every year, until it was finally plowed up to give place to a tobacco crop.

Timothy is thought to be a great exhauster of the soil. This is doubtless true, but its capacity in this respect is not greater than that of Indian corn, wheat or tobacco. It has been well said that a crop that does not exhaust the soil is not worth gathering; that it is impossible to get from the soil something for nothing. The duty of every farmer is to restore to the soil, by commercial fertilizers or by home-made manures, some of the valuable nutritive elements that are taken from it by the crops.

STACKING OR RICKING HAY—There is no particular skill required in making stacks. A pole about twelve or fifteen feet long should be planted firmly in the ground. Around this a platform for the foundation of the stack should be built. This should be ten or twelve inches high and as broad as the proposed diameter of the stack. The bottom of the stack or rick should cover this platform completely and for the height of six or eight feet the stack should be broadened out so as to throw any rain that may fall upon it outside of its base. The most convenient size of stack for a majority of farmers is one that will contain four or five wagon loads of hay, a quantity that may be hauled up in a day or conveniently accommodated in the stock barn. When a stack is once broken the whole of it must be carried to shelter or it is liable to be caught and injured by rain. In stacking, the hay should be compacted around the pole and practice alone will teach one how to preserve the symmetry of the stack and give to it the lines of beauty and utility. The handrake must be used in combing down the sides of the stack.

A rick may be made of any required length with a width at the base of from 12 to 15 feet. This width should be gradually increased to the height of seven feet or more. No poles are necessary in the making of a rick, but a good substantial platform for the hay to rest upon is necessary. The width of the rick after the height of seven or eight feet should be gradually contracted like the roof of a house. The rake should be freely used in combing the sides. It is necessary when first put up to secure the top against strong winds by passing grass ropes over the rick and fastening them to the ground on each side. These ropes must be put at intervals of six or eight feet throughout the entire length of the rick. After the hay has been well settled, the ropes may be dispensed with.

The use of hay knives, which have recently been introduced, enables the farmer to haul away just such quantites of hay from his rick as he may desire. With these knives a vertical section is cut from one end cleanly and evenly from the top to the bottom of the rick. The introduction of hay knives has made the rick more popular than the stack.

Every large hay-grower now bales his hay. The most popular size for a bale is one that will weigh 100 pounds. A bale of this size is more easily handled, and thus adds value to the hay. There are many persons who make a business of baling hay, going from farm to farm like those engaged in threshing wheat. They charge a certain price for baling and furnishing the wire, regulated somewhat by the prices of hay. Every farmer who raises more timothy hay than is necessary to meet the requirements of his own farm should bale it before carrying it to market. The farmers in every thickly settled community would do well to sow timothy enough to justify them in buying a baling press, which in the marketing of 300 or 400 acres of hay will pay for itself in a single year. The press could also be used in baling clover hay and wheat straw, the latter being worth when baled, four dollars per ton or more.

A FEW PRECAUTIONS—(1) Do not sow without testing beforehand the power of germination in the seed.

(2) Do not sow anything but clean seed. Examine for noxious seeds with a magnifying glass.
(3) Do not sow when the soil is very dry and cloddy.
(4) Do not cover the seeds to a greater depth than one-fourth of an inch. When covered 2 inches very few, if any, will germinate.
(5) Do not pasture a timothy meadow at any time; the destruction of the bulbous roots will soon exterminate the grass.
(6) Do not cut the grass below the first joint.
(7) Do not forget that blue-grass is the arch enemy of a timothy meadow. Therefore never permit stock from a blue grass pasture to roam over a timothy meadow.
(8) Do not fail to exterminate all bunches of "broom-sedge" and all "yellow dock" that may appear in the meadow during the summer. Never let these go to seed.
(9) Above all do not forget to top dress your meadow with suitable manure in the fall of the year and with superphosphate in the spring. Feed your meadow and it will feed you.

HERD'S GRASS, RED TOP, FINE BENT, FIORIN, (*Agrostis alba or Agrostis vulgaris.*)—(Pasture and Meadow.)

Recent botanical investigations have determined the fact that herd's grass is greatly modified by climate, soil and situation. The most appropriate name for it is probably agrostis polymorpha, on account of the many forms which it assumes when subjected to different conditions. By whatever name it may be designated in various localities it is one of the most useful agricultural grasses of the south. It will grow upon every soil, and will give more general satisfaction to the farmer than any other grass. It is scattered over the whole state of Tennessee. The writer has seen it growing luxuriantly upon the hightest mountains of East Tennessee, as well as in the deepest valleys; on the sandstone soil of the Cumberland table-land, and upon the cherty soils of the highland rim. It sparkles in the beauty of its verdure on the limestone soils of the central basin and acquires its largest growth in the sandy river and creek basins of West Tennessee. There is no place in Tennessee in which it does not prove a profitable grass to the farmers.

Herd's Grass, Red Top—Agrostis alba.
2. Panicle. 3. Spikelet. 4. Empty glumes. 5. Flowering glume.

Even upon the galled and worn-out soils, if sown and top dressed with a small quantity of stable manure, it will be a powerful factor in the reclamation of the soil and at the same time it will yield a large amount of good grazing. It is not only a good meadow grass but it is one of our best pasture grasses. Grazing indeed is almost necessary for its perpetuation and preservation. It loves a moist soil best and on swampy places that are unfit for the growth of almost any other useful grass, herd's grass will thrive in the greatest vigor.

PERMANENT AND ADAPTED TO EVERY SOIL—By all odds it is the most permanent grass for all soils. Blue grass is very dainty in the selection of its soil. Timothy must have moist and rich but not wet soils. Clover even, the greatest of our forage plants, will only grow well upon rich calcareous loams but herd's grass is a universal feeder and as such is of use to every farmer, whatever may be the character of his soil or the location of his farm.

In a wet soil, especially, herd's grass sends out is long creeping roots and takes full possession. It assumes in such situations a stoliniferous form, that is to say it sends out shoots from the base, which take root at every joint and produce a thick dense sod. A pasture of herd's grass where it is well set is much valued by dairymen everywhere for it will bear tramping and will continue its growth for a longer period during the year than almost any other grass. When the grass has been cut for hay its aftermath makes the very best late summer and fall pastures.

A HAY AND PASTURE GRASS—It does not rank as high as timothy as a hay grass but as a combined hay and pasture grass it deservedly stands at the head of all economic grasses in Tennessee. When sown upon lands inclined to be wet it often attains a height of four feet. The writer has seen it growing in the sandy creek bottoms in Carroll county five feet high and so rank as to yield three tons of hay to the acre. Usually upon uplands it will attain to a height of from two to three feet. When in full bloom its purplish or brownish panicles present by their feathery undulations a most charming sight.

WHEN AND WHERE TO SOW—Herd's grass may be sown in the fall or in the spring. It may be sown alone or with a nurse crop, as wheat, barley, rye or oats. If the farmer should desire to sow it for a meadow it is best sown alone, about the first of October, upon land well pulverized by plowing and frequent harrowing. One bushel of seed in the chaff is not too much to sow to the acre. Of clean seed half that quantity evenly distributed will be ample. For the making of hay it should not be sown upon uplands, unless the soil is very fertile or the land freshly opened to cultivation. While it is the best of all grasses for pastures upon thin soils, it yields upon such soils but a small quantity of hay.

In England it is supposed to grow best on sandy soils, and such is the experience of the farmers in West Tennessee, but in other parts of the state the best results are obtained by sowing it upon a deep calcarous loam. It makes a fair meadow grass upon the sandy soils of the Cumberland table-land, but the places for such meadows are usually selected in creek basins where the sandy soils are moist. Notwith-

standing this grass prefers a wet soil, it has the ability to withstand severe droughts even when sown upon dry uplands. It will retain its verdure late in the fall and even in winter when it has not been pastured during the summer or cut for hay. Under these conditions the old grass falls down and forms a protection for the young sprigs which keep green during severe frosts and hard freezes. Good winter pastures of this grass are especially valuable for ewes at lambing time, the green grass producing a copious flow of milk when the young lambs most need it.

Herd's grass is often sown with other grasses and leguminous plants, and especially with timothy and clover. These additions largely increase both the quantity and quality of the hay, but they do not permanently benefit the pasture, as the clover, being a biennial plant, soon disappears and timothy cannot survive the heavy tread of cattle or the compact tramping of sheep.

For stopping gullies no grass except the Bermuda is equal to herd's grass. Like Bermuda-grass it will send its long rhizomes down the sides of the gullies which take root at every joint and will, in a short time, cover the silty deposits in the bottom of the gullies. This mat of grass will catch and hold the soil carried by the water after a rain, thus gradually building up the bottom until it can be crossed with a plow.

WHEN TO CUT FOR HAY—The proper time for harvesting herd's grass so as to secure the best quality of hay is when in full flower or as soon thereafter as possible. When seed is the main object it should not be cut until fully ripe. It is more easily cured than almost any other hay grass. Cut in the morning of a clear day after the dew has been dissipated by the warmth of the sun it should be ready, unless very heavy, to be raked up into windrows in two hours, and put into cocks in the late afternoon. Remaining in cocks for another clear day it may be stacked or ricked without the least danger from over-heating or fermentation in the stack. If there should be any doubt in this respect it must be watched, however, for a day or two, and if an undue amount of heat should be generated the stack should be torn down. Rarely is this necessary and care should be taken not to put the hay in stacks until it is fairly well cured. The less the hay is exposed to the sun the better and sweeter it will be. Mr. P. H. Marbury, of Warren county, Tennessee, who for many years was a most successful cultivator of this grass, thus gives his experience with it:

"As a meadow or grazing grass it is very valuable. It yields on good soil from a ton to one and one-half tons of superior hay, the stems and blades much fewer and somewhat softer than timothy. I prefer it to timothy—my stock prefer it. For grazing it is very valuable. Upon land where limestone is absent it flourishes, has greater tenacity of life, makes a sod almost impervious to hoof and tooth—in fact it is the blue-grass of the mountain district. We have but little lime in our soils and therefore blue-grass does not grow well. For a meadow I prepare the soil well with plow and harrow and sow one bushel of clean seed per acre, one-half one way and then sow the other half across the first so as to avoid leaving spaces unoccupied. A light brush may be dragged over it or not, as is preferred. I prefer to leave it without brush or roller. The roller is better than a brush; in fact it prepares the surface well for

the mower or scythe. If sown alone the first of October, a crop of hay the next season may be cut perhaps equal to any it will ever afterward yield and worth more than a crop of wheat or corn.

"The time to cut for hay is just before the seeds ripen, but if seeds are desired let them ripen, and, if cut immediately, it will still make fine hay. For pastures I would advise a mixture of orchard grass with it. Orchard grass grows well in the same soil with herd's grass."

The seed of herd's grass is very easily saved. The grass may be cut with a self-binding reaper when the seed attains maturity. The bundles may be put into shocks without caps and the seed will be dry enough in a few days to thresh. It is difficult to separate the chaff from the seed as the seed is very light but the stand will be just as good to sow the seed in the chaff as to have it clean. Herd's grass seed in the chaff sells low and there should be no stint in the sowing. Some people recommend the sowing of two or three bushels to the acre and even as high as four when a dense sod is wanted in a lawn or pasture. The experience of the writer is that one bushel to the acre in the chaff is sufficient when sown for pasture upon land thoroughly prepared.

ORCHARD GRASS—(*Dactylis glomerata.*)—(Pasture and Hay.)

Orchard grass is diffused extensively all over Europe, from Norway and Russia to Portugal and is also found growing in Northwestern Africa, in India and in Asia Minor. It is cultivated with profit in all the states east of the Mississippi river that lie between 35 and 47 degrees north latitude, and in nearly every state between the Mississippi river and the Rocky Mountains. In New York it is the favorite grass. It was known in England for many centuries but its good qualities were not appreciated until it was introduced into that country from Virginia in 1764 by the Society of Arts. It is a very hardy perennial, a vigorous grower and flourishes as well in the shade as in the sunshine. Owing to this habit of the grass it takes the name of orchard grass in the United States. In England it is called cock's-foot. It is grown with success in woodland pastures, having generous soils.

Orchard Grass—Dactylis glomerata.
2. Inflorescence. 3. Upper leaf. 4. Spikelet. 5. Empty glumes. 6. Floret, with stamens and pistil.

SOILS — Orchard grass grows upon every soil not saturated with water. Its preference is an alluvial soil, moderately dry, porous and with a considerable amount of sandy material in it. Stiff, clayey

soils, retentive of moisture, do not suit it so well. Upon this class of soils the roots acquire such a feeble hold that they are liable to be thrown out by winter freezes. In England, however, Mr. Wheeler, a writer on grasses, recommends it among those grasses suited "for a poor stiff soil or a dry subsoil."

Mr. Edmund Murphy, of Ireland, states that it is most advantageously used in the sandy soils of Norfolk.

It will grow well upon a soil naturally sterile, provided it is top-dressed with stable manure. Upon freshly cleared lands where there is a considerable amount of virgin mold it grows with a surprising luxuriance, getting a good start early in the spring and growing successive crops until fall. One of its chief merits lies in the earliness and rapidity of its growth, furnishing a grateful bite to horses, sheep and cattle long before any other grass. It retains its verdurous appearance during the hot days of August when grown upon a rich deep loam.

As a hay grass it does not rank high in the estimation of Tennessee farmers. Upon good soils it attains a usual height of three feet but sometimes reaches four and even five feet. The stalks when grown on rich soils are coarse and woody, unless the grass is very thick. As a hay, unless cut very early, it is not relished by stock to the same extent as clover, timothy or herd's grass hay. Nevertheless it makes, upon good soils, a large quantity of medium quality. If cut before the leaves begin to be embrowned or to dry up and before the seed begins to form it is greatly relished by stock, though it is deficient in nutritive matter.

The Woburn experiments developed some interesting facts pertaining to this grass. Grown upon a rich, sandy loam, and cut the middle of April the green grass weighed 10,209 pounds per acre, in which there were 1,190 pounds of nutritious matter. Cut, when in full bloom, the green produce weighed 27,905½ pounds. It lost in dessication 16,045 pounds, or a little more than half, and furnished 1,089 pounds of nutritious matter. After the seeds were fully ripe, the green produce weighed less by 1,361 pounds per acre, but there were 1,415 more pounds of dry hay, with an excess of nutritive extract of 363 pounds. The aftermath, however, was not so good, and in the loss of this the advantage of an increased yield of hay was counterbalanced.

Its best record as reported by Sinclair was 27,905 pounds of green grass; 11,860½ pounds of hay and 11,910 of green aftermath per acre. The following account of the extraordinary productiveness of this grass is given by Mr. Falla, nurseryman and seedsman, of Newcastle-upon-Tyne, in the Quarterly Journal of Agriculture:

On the 30th of April he weighed the produce of a square yard, and found it to be 16 pounds or 34½ tons per acre; the second crop of this yard was cut again on the 10th of June, and weighed 8 pounds. The third crop was cut on the 10th of September and weighed 10 pounds—in all equal to 73 tons as the year's produce. He remarks that it was, in every case, weighed on a dry day.

HOW AND WHEN TO SOW—The land if inclined to be tenacious or stiff in its character should be well-broken in the fall, rebroken the following March or April and thoroughly harrowed just before sowing

until the top is as mellow as garden mold. If a sandy soil is selected it will not benefit it or render it more pulverulent by plowing it in the fall. When the soil becomes dry enough to plow the land should be prepared and the seed should be sown before a rain compacts the land.

Orchard grass always does best in Tennessee when sown early in the spring. From the 15th of March to the 15th of April is the best time. Not less than two to three bushels of seed should be sown to the acre. As the seeds are large a light harrow must be dragged over the land after sowing so as to cover them well. The greatest objection to this grass is its tendency to grow in stools or tussocks leaving large bare interspaces. To correct this habit a fine toothed harrow should be run over the pasture every spring and wherever there is a vacant place more seed should be sown and carefully covered. A roller run over the pasture when the land is wet represses this tendency to form tussocks. Mr. Edmund Murphy recommends the sowing of ten pounds of red clover per acre as a preventive of this proclivity.

Orchard grass is a very vigorous grower, surpassed in this respect by but few in the whole catalogue of domestic grasses. It is succulent and nutritious and when mowed it requires only a few days of moist weather to bring out its verdant blades in as great beauty and vigor as ever. It will bear more grazing than almost any other grass because of this rapid growth. Tramping does not seem to affect it in any other way than by inducing a tussocky growth. Two or three crops of it may be cut in one season when grown on a deep, rich and moist soil but after each cutting it should be top-dressed with superphosphate of lime or with stable manure.

Mr. W. D. Gallagher gives the following directions for sowing orchard grass: "Plow the land deep, pulverize the soil well, be generous as to the quantity of seed, let the seed be good, sow it evenly, give the land as good treatment afterwards as is given to meadow lands in timothy."

VIRTUES OF ORCHARD GRASS—Orchard grass is a long liver and will be victorious in a contest for supremacy in the pasture over other grasses provided always that its tendency to grow in tufts be counteracted. Mr. L. F. Allen, of New York, a farmer and stock grower of national reputation, testifies to the fact that he has had it growing in one field for a period of forty years with continuous mowing and pasturing. He says that if cut at the right stage it is just as good for any kind of animal as timothy hay.

Mr. T. A. Cole, of the same state, says that after twenty years of experience he has settled down upon orchard grass as possessing greater merits than any other for both pasture and meadow, for fattening animals or for dairy stock. Of its value for dairy purposes he says: "When cut for hay just before it blooms and cured with as little sun as possible it will make more milk than any other variety known to me; if left to ripen, it is worthless."

When grown for hay therefore it may be cut and cured before clover, timothy or herd's grass is ready for the mower and in this there is a great advantage. The yield of hay on fertile land is two tons to the acre.

As to its capacity for furnishing grazing Col. Bowman, writing from

the blue grass region of Kentucky, says: "Owing to its capacity to resist drought and in consequence of its rapid growth it will yield more pasturage than the best blue grass sod."

Its superiority to timothy lies in the great value of its aftermath. It will improve under depasturing when a timothy meadow subjected to the same treatment would be destroyed. It also makes an excellent winter pasture. Prof. Phares, of Mississippi, an expert writer on grasses, says he prefers orchard grass to any other grass.

Mr. Howard in his manual on grasses thinks it stands in importance, for the climate of Georgia, second only to meadow-oat grass for hay and winter pastures. Where hay is the object he recommends that meadow-oat grass and orchard grass be sown with red clover and white, as each of the four blossoms at the same time. The cultivation of orchard grass and meadow-oat grass he thinks cannot be too strongly recommended for the south.

Hon. N. B. Dudley, of Logan county, Kentucky, a most successful stock-grower, has this to say of orchard grass:

"Orchard grass with a good stand on medium to good land will furnish more grazing than any other of the grasses in common use. It starts on its spring growth sooner, is less affected by a summer's drought and grows later in the fall than any other grass. It is the best yard grass for farmers who love large yards and many shade trees. But to get the most benefit from it, it should be grazed hard enough to keep the blades short and tender. If they are permitted to grow long they become tough and rough to the mouths of stock.

It is not a sod grass like blue, herd's and Bermuda grass. It is more like timothy, growing its tillers from the parent plant, each tiller having a bulbous quality at its base and it should never be grazed hard enough for these bulbs to be eaten by stock for that would soon destroy the stools from which they grow.

Orchard grass does very little towards reseeding or thickening itself on the ground. The stools seem to love to have a little neutral territory around themselves. Good farmers usually sow blue and herd's grass to fill these spaces and some sow timothy also because it gives a mowing the next summer. Stock should be kept off of orchard and blue grass for two winters after seeding.

It is the nature of orchard grass to grow blade in the fall and seed stock in the spring. It should therefore have a good holiday in the fall. Orchard grass is not one of the best hay grasses. The seed stalk will get hard whether it is cut early or late but a very fine hay can be had by sowing with it the common or medium red clover. They are ready for the mower at the same time. I have seen its blades four feet long and the stand of grass seriously injured because it was neither mowed nor grazed. I love orchard grass because it will grow well on land where blue grass would be too dwarfish for profit."

SAVING SEED—When seed is the object the grass should be cut with a self-binding reaper and tied up in bundles as wheat or oats. The bundles are put up in shocks without being capped. They should remain in this condition until dry enough to thresh, which will be in three or four

weeks. They should be threshed from the wagon and some care must be exercised in hauling the bundles to the thresher, otherwise many of the seed will be lost by shattering. The yield upon rich soils is fifteen bushels to the acre. It is put up in eight bushel sacks and the weight is 14 pounds to the bushel.

Lawes and Gilbert, by selecting the best seed and sowing for several years none but the best for several generations, established a new variety which they called giant cock's-foot. The seed of this weighs only 10 pounds to the bushel, and there are only 34,000 seed to the ounce in place of 40,000 of the ordinary orchard grass. This so-called giant orchard grass is not in any respect superior to the common variety.

It may, with confidence be said of orchard grass that it will suit the ordinary Tennessee farmer better than any other grass for all purposes except herd's grass, and it may with safety be recommended. It soon arrives at maturity. It thrives upon almost every soil and in every variety of situation. It produces an immense amount of herbage and hay. It grows very rapidly and is a favorite with all kinds of cattle, especially when grown in the sunshine. It is found in the best English and American pastures. It does not impoverish the soil and is not hard to destroy when the land is wanted for other crops.

Summing up the merits of this grass it may be said:

1. It is better suited to every variety of soil than any other except herd's grass. The writer has seen it growing with vigor on mountain heights and in valley plains, on sandy loams and calcareous soils; on the coarse sandstone soils of the Cumberland Mountain, and on the tertiary loess and alluvium of West Tennessee, as well as upon the cretaceous sands of that division. He has grown it with success upon the siliceous soils of the rimlands, and has seen it enliven the landscape of the Central Basin with its mantle of verdure. It is best adapted to the sandy loams of West Tennessee and to the lands of the Central Basin having a porous subsoil. On lands having a tenacious clay foundation, the roots are checked in their descent, and the growth is not so luxuriant; nor is the duration of the pasture so great.

2. It will grow with greater rapidity than any other grass and for this reason will sustain a larger number of stock. It is excellent for soiling purposes.

3. It will grow in the shade. This quality will enable the farmers to utilize their woodlands as pasture, and so make them a source of profit.

4. It will resist drought better than almost any other grass. The hot summers make this a very valuable quality in any grass. Often in July and August the pastures become so parched as to afford but a small amount of grazing. Orchard grass then comes to the rescue and supplies the deficiency.

5. It is both a pasture and a hay grass. After a crop of hay has been taken off in May or June, the aftermath will furnish a good pasture throughout the remainder of the summer. A prominent sheep raiser of Tennessee who has been carrying a thousand sheep or more, says that during the summer it will carry double as many sheep as blue grass, acre for acre; but that blue grass will furnish more and better winter grazing.

6. It may be sown in the spring or fall with small grain or alone. It is best not to sow it with grain, as the extra production of grass, when sown alone, is worth more than the grain and grass grown together. It may be mown as hay or cut with reapers or cradles, and bound in sheaves like oats.

MEADOW FOXTAIL—"MOUNTAIN TIMOTHY."—(*Alopecurus pratensis.*)—(Meadow and Pasture.)

This grass is one of the earliest in making its appearance in the spring. Its tall culms and club-like panicles are charming in their robes of golden anthers. They are so much earlier than the panicles of other grasses that they readily attract attention. In England this grass is in almost every pasture, and in many pastures famous for their richness and luxuriance it is the principal grass. It blossoms in Tennessee in March and early April.

SOILS SUITED FOR ITS GROWTH—It grows best on rich, moist, strong soils. A calcareous loam with a loose gravelly subsoil is well suited for it also, but it will thrive upon all soils except the dryest sands. It may be grown with success in every part of the state, even upon the Cumberland table-land, wherever the underlying subsoil is clayey and retentive of moisture.

Meadow Foxtail—Alopecurus pratensis.
2. Inflorescence. 3. Upper leaf. 4. Spikelet. 5. The awned flowering glume, the stamens and stigmas projecting from the apex.

Prof. Beal says "it is quite common at elevations of from five to seven thousand feet above the sea, growing in rich soils along mountain streams and frequenting the so-called mountain meadows." "For the more elevated meadows of the Rocky Mountain region and for northern latitudes there is no grass that so highly commends itself as this for hay and summer grazing."

This grass would do best in Tennessee in the moist and cool climate of the Unaka mountains. The rich soils of the sheltered valleys and coves of that region, and also that upon the "Balds," are probably better suited for its growth than any other soils and situations in the State. In England it is a great favorite in the sheep breeding districts. It very much resembles timothy in general appearance, but while the head of timothy is rough and harsh to the touch that of the meadow foxtail is soft and velvety, but broader and shorter. The hay, however, is much lighter than that of timothy, while the bulk may be greater. Its chief value in

Tennessee is for pasturage, because of its earliness and the rapidity of its growth, resembling in these particulars orchard grass. It excels timothy for pastures as much as timothy excels it for hay. Like most grasses its greatest nutritive value is attained when in full bloom. When cut at that period it loses over 70 per cent. in drying and contains when green 4.32 per cent. of albuminoids as against 3.79 per cent. for timothy cut at the same stage.

One great drawback to the introduction of this grass is the length of time (three to four years) it requires to be firmly established, but it is well adapted to permanent pastures and many mountain districts in the state could be greatly benefited by its introduction. It is a long liver, a quick grower, and furnishes a very nutritious and palatable herbage. It requires about three bushels of seed to the acre to insure a good stand but it is best to sow it with other grasses. The land may be prepared and the seed sown in the fall. In the moist climate of the Unaka mountains it may be sown either in the spring or fall. The plant at first is very feeble and should only form one of the grasses in a pasture. After two or three years it makes the principal grass.

Mr. Taunton, of England, thus speaks of its durability and good qualities:

"In the dry soil, in the course of seven or eight years, it became much weakened; but in a meadow on the clay with a dark moory mould on the surface, it maintained its size, frequently as well or better than any other grass; and where I had sown it on deep loamy sand where springs rise, there its produce was extremely luxuriant, insomuch, that I, this year, sold the crop standing at the rate of 8 pounds sterling ($40) per acre. No manure had ever been given to this land since the grass seeds were sown seven years ago, other than the irregular irrigation produced by the winter springs; yet it most completely covered the ground. One character particularly attracted my attention; namely, that although it stood late in the summer—not having been cut until late in July, and after the seed had fully ripened—none of the lower leaves had decayed or withered, whereas those of the cock's-foot and fescue and some others were quite dead. This experiment proves to what a valuable purpose any tract of springy, moist, loamy sand may be converted by sowing it down with a selection of grasses, in which the foxtail should predominate.

This grass must not be confounded with the foxtail (*setaria viridis*) that springs up in the fields of Tennessee after oat and wheat harvest. This foxtail is nothing but a troublesome weed.

TALL MEADOW FESCUE—RANDALL GRASS—EVERGREEN GRASS—(*Festuca elatior* var. *pratensis.*)—(Meadow and Pasture.)

This is a most valuable grass and well suited to many of the soils of Tennessee. It is a perennial and flourishes best on moist lands rich in humus. It is good for permanent pastures or meadow, producing when cut in flower a large amount of excellent hay which Mr. Sinclair values next to the meadow foxtail. As a hay grass it is superior to the meadow foxtail. It is common throughout Great Britain, Lapland, Norway, Swe-

den, Germany, France and as far South as Italy. It grows all over the United States. It was first domesticated in 1820. It is inclined to grow in tufts or bunches like orchard grass. The roots are stout and the leaves are from one to two feet long. This grass often grows to the height of five feet in suitable situations and soils and makes excellent winter pastures from Virginia and Kentucky southward. It grows vigorously on the mountain lands of upper East Tennessee and is highly prized for its good grazing qualities during the spring, summer and fall months, even extending far into winter, notwithstanding the rigor of the weather upon these chilly heights. It has taken various names; in Virginia it is "Randall grass;" in North Carolina "evergreen grass." In the mountain lands of Virginia, a writer says: "The variety of forage best adapted to sheep-grazing on the mountain lands is the 'Randall.' a tall, coarse grass, growing freely on the rocky soil to a height of six feet, remaining green and affording fine herbage all the winter."

Fall Meadow Fescue,—Festuca elatior.
2. Panicle. 3. Upper leaf. 4. Spikelet.
5. Empty glumes. 6. Flowering glume.

From the limited cultivation this grass has received in Tennessee it seems to be adapted rather to moist low lands than to uplands, though I have seen it growing on some of the high ridges of East Tennessee, at least 1,500 feet above the sea. There, on good soils, it thrives luxuriantly, and makes a very superior pasture. Some of this grass was sown in Davidson county as early as 1850 upon the farm once owned by Col. D. H. McGavock. The place selected for sowing was low, wet and almost marshy. The same spot is yet green with it, still flourishing in the greatest vigor, furnishing more grazing according to Col. McGavock, than any other grass. The roots penetrate much deeper than the roots of bluegrass, descending indeed, as deep as red clover. In consequence of this it bears droughts remarkably well. Nor do overflows affect it, but seem rather to add to its vigorous vitality.

A small plat of upland was also sown, but it disappeared in about five years. Its disappearance, however, was hastened by the presence of the army worm.

In Europe this grass is one of the standard meadow grasses and might be found by further experiment to form a fine addition to the list here. Its name of evergreen originated from its habit of remaining green

under the snow, affording fine croppings for cattle. It will grow on a greater elevation than the blue grass.

Meadow fescue grass does not attain its full productive capacity until the third or fourth year, so that while its durability in the soil is great it may not be depended upon for a quick meadow or pasture. It will yield the first year from one to one and a half tons of hay when sown upon congenial soil, and twice that amount the second year. The seed weighs from 12 to 16 pounds to the bushel and three bushels are required to the acre. Prepare the land and sow at the same time of the year and in the same manner pointed out for the sowing of blue grass. In sowing it for pasture it is usual to mix it with other fescue grasses.

This grass has never received the attention in the south it justly merits. It is greatly relished by all herbivorous animals. It is a vigorous grower, resembling in this particular, after being well established,

Sheep Fescue—Festuca ovina.
2. Inflorescence. 3. Spikelet. 4. Empty glume. 5. Flowering glume.

Tennessee Fescue—Festuca rubra glaucescens.
2. Inflorescence. 3. Upper leaf. 4. Spikelet. 5. Empty glume. 6. Flowering glume.

blue grass, though it takes two or three years to reach the condition of its greatest fruitfulness. It is fairly nutritious both in its green and cured state.

SHEEP FESCUE—(*Festuca ovina.*)—(Pastures.)

This is a very hardy perennial and deserves mention in this bulletin because it will grow on thin, dry, siliceous soils and thus fills a want in those regions of Tennessee that are destitute of good grass lands and are now practically without grasses. On the sandy soils of the Cumberland table-land and on the siliceous soils of the Highland Rim and on the sandy areas of the cretaceous formation of West Tennessee this grass would prove a boon. The gravelly ridges of East Tennessee could also

be made good sheep walks if set with it. Sheep are very fond of it and hence its name.

Its panicles are narrow; its leaves are short, bristle-like and tufted and have a grayish color tinged with red. It forms a profuse foliage in bunches and makes excellent pastures for sheep and cattle where other grasses will not grow.

This grass constitutes the great bulk of the grazing grasses in the sheep pastures of the Highlands of Scotland. It is believed by the shepherds in that region to be more nutritious for sheep than any other. In the arid plains of Asia it is often the only grass upon which the wandering tribes can subsist their cattle and sheep.

Linnaeus asserts that sheep have no fondness for hills without it. Where all other vegetation parches up it will grow. Its short and dense turf when sown thick makes it well suited for lawns. The aftermath in a lawn cannot be surpassed.

Many varieties of this grass are found in the Rocky Mountain districts. Some of these grow to the height of two or three feet. The usual

Rats's-tail Fescue—Festuca myurus.
2. Inflorescence. 3. Upper leaf. 4. Spikelet. 5. Empty glumes. 6. Flowering glume.

Small Fescue—Festuca tenella.
1. Panicle. 2. Spikelet. 3. Empty glumes. 4. Flowering glume.

height of this grass on thin soils rarely exceeds eight inches. The weight of a bushel of seed is 14 pounds. Two or three bushels to the acre is not too much to secure a sufficient density of turf for lawns or pastures. The seed sells for about $2.00 per bushel.

OTHER FESCUE GRASSES.

Tennessee fescue, *Festuca rubra glaucescens*, is a perennial and is strongly recommended for worn out soils and hill-sides. It has a creeping habit and makes a good turf, close and fine leaved, remaining green

throughout the year. It is not easily affected by either drought or cold. It will grow well on dry sandy soils and may be a valuable acquisition for the Cumberland mountains.

Festuca myurus (rat's-tail-fescue) and tenella (small fescue) are both annual grasses which grow on dry sandy soils six inches to a foot in height, and, as they appear early in the spring, they make a good sheep pasture.

Festuca duriuscula, hard fescue, is a variation of the sheep fescue and will thrive on poor sandy soils. It is of but little value where the soil is fertile enough to produce better grasses. But for its hardy nature and its adaptability to unfavorable situations it would not be mentioned.

Differences in soil and situation cause these species to run into several varieties and the narrow leaved species seem to lose their individuality when grown on like soils and under similar conditions. Prof. Buckman of the Royal Agricultural College at Cirencester sowed in experimental plots the seeds of *Festuca ovina*, *Festuca ruba* and *Festuca duriuscula* and for two years the specific differences were well marked but in the third year these differences vanished and the appearance of all three was practically the same. The creeping habit of the Festuca rubra was totally lost. On poor upland regions, according to Mr. Gould, these fescues assume the appearance of the Festuca ovina; on good uplands the appearance of Festuca duriuscula and in river valley lands of Festuca rubra.

PERENNIAL RYE GRASS—RAY GRASS—(*Lolium perenne*)—(Meadow and Pasture).

This grass has been in cultivation in England and Scotland since 1667 and in France for even a longer period. It is regarded in England very much as timothy is in the United States, though it is difficult to see the reason why. It is a short perennial, lasting usually from three to seven years and in consequence of the shortness of its life it is not highly esteemed for pasture. It is a good grass, however, for alternate husbandry.

SOILS—Like nearly all stoloniferous grasses it prefers a moist soil and is especially suited to a low-lying clayey soil. The roots put out several stems, which grow prostrate at the base. Upright stems ascend from each joint of the prostrate stem, attaining a height of from two to three feet. The stem is stiff; the spike is flattened and it is not an attractive grass in appearance, but it has a full green tint except at the joints of the stem, where it sometimes takes on a brownish hue. It has a vigorous habit, starting early in the season and flowering early. It requires one to two bushels of seed to sow an acre. It may be sown either in the fall or spring when the land is in good condition. The preparation of the land is the same as that for orchard grass.

Prof. Beal does not think it well adapted to a southern climate as it cannot bear great heat. It must have a cool climate and a moist soil. These conditions of growth are found among the high mountains of East Tennessee and I have no doubt it would grow with great luxuriance in

the moist soils of the elevated valleys and coves found among the Unaka mountains.

On fertile soils it will yield about 40 bushels of seed to the acre and the seed weighs 25 to 30 pounds per bushel. It cannot be called an economical grass for pastures or meadows. Its shortness of life makes the sowing of it for permanent pastures or meadows very bad husbandry. The sowing of it is only a little more economical than the sowing of an annual. And yet for a three years rotation it will be found very useful.

Mr. Edmund Murphy, a close observer of the habits of this grass says: "In laying down some hundred of acres with this grass alone or in mixture with others my experience fully bears out the justice of the charge of bad husbandry in sowing it for permanent meadows or pastures. Nor is the want of durability its only bad property. It is perhaps the most exhausting of all the grasses on land, nearly as much so indeed,

Perennial Rye Grass—Lolium perenne.
2. Inflorescence—a spike. 3. Upper leaf.
4. Spikelet, with a portion of the rhachis.
5. Empty glumes of the terminal spikelet.
6. Floral glume. 7. Palea. 8. Caryopsis.

when permitted to form its seed, as a crop of corn (wheat). In dry soil or in almost any kind of soil, should dry weather set in after it has been cut, an almost total failure of the aftergrass will be the result. Its greatest value appears to be for sowing with clover, on land intended to remain only two or three years in grass; with this view, and when sown at the rate of one bushel per acre, with 20 pounds of red clover; or two bushels of rye grass, and 14 pounds of red clover on deep rich ground, enormous crops are produced. When the intention is to leave the land only one year in grass, the Italian rye grass is greatly to be preferred."

According to the Woburn experiments it is very low in its nutritive elements. It ranks low as to the quantity and quality of its produce and

in its aftermath it is the very lowest in the scale of cultivated grasses. Compared with orchard grass its nutritive power is as five to eighteen; to meadow foxtail, five to twelve; to meadow fescue, five to seventeen. Nevertheless it is a useful grass in a mixture and will furnish the earliest of grazing. It possibly may be recommended for culture in Tennessee only on the soils of the Unaka mountains and on the moist low clayey lands adjoining the lake districts of West Tennessee.

ITALIAN RYE GRASS—(*Lolium Italicum.*)—(Soiling and Hay).

This is a sub-perennial grass and is esteemed among the very best of the short-lived grasses. Its period of duration is two to three years. It gives more abundant crops of a better quality than perennial rye grass. It is characterized by Flint as being the "greatest glutton of all the grasses;" will endure any amount of forcing by irrigation, by timely rains, and by manuring. It will withstand a drought remarkably well, notwith-

Italian Rye Grass—Lolium Italicum.

2. Spike. 3. Upper leaf. 4. Lateral spikelet, with a portion of the rhachis. 5. Empty glumes of the terminal spikelet. 6. Floral glume.

standing its capacity for absorbing moisture from the earth. It has within the past fifty years been introduced into America from Europe where it is claimed to be more universally adapted to all kinds of climates than any other domesticated grass.

SOILS—Italian rye-grass reaches its highest perfection on moist, rich, alluvial lands and calcareous loams where the soil is in good tilth. It is not recommended for permanent pasture or meadow but owing to its rapidity of development it is of the greatest value when an early crop of forage is desired. With proper manuring it is said that it may be cut within three to four weeks after seeding. A succession of crops may be

cut every four or five weeks during the season. This quickness of growth makes it stand in the first rank as a soiling grass. For dairymen living near a city it is of especial value as the green food produces a rich flow of milk at a very small cost. One and a half to two bushels of seed, weighing 20 pounds to the bushel, is about the proper quantity to sow on an acre of land. Prepare the land and sow in the same manner as orchard grass. It is, however, better when sown in the fall, about the first of October. It may be considered a very valuable grass for Tennessee and indeed for the south generally. It has been fully tested in Georgia and in Tennessee, and it has in every instance given satisfactory results.

It gives a fine color to the butter of the milch cows fed on it, and they eat it with great relish. It withstands the hottest suns of summer as well as the frosts of the severest winter. It must be sown alone, as it will quickly choke and destroy clover or other grasses. Its yield per acre, according to received authority, is something immense. Mr. Dickens, of England, sowed it on a stiff, clay soil, well-manured, cut it ten times during one year; the first time, ten inches, in March; April 13th, again, and May 4th, a third time; May 25th, a fourth time; June 14th, again; July 22nd, a sixth time, with ripe seed and three loads of hay to the acre. Immediately after each cutting it was manured with liquid manure, the produce of each crop increasing with the temperature of the atmosphere, from three-quarters of a load, the first cutting, to three loads the last. He discontinued manuring now, thinking its growth would be terminated in bearing seed, but he afterwards cut four crops from it. On the 26th of January following, it measured sixteen inches in height. The last cutting was October 30th, and on the 8th of April a crop twenty-two inches high was cut from it. "I was desirous to know the exact amount taken per acre for the year, and it amounted, on a careful measuring and weighing of green hay, thirteen tons and eighteen hundred and twenty-seven pounds per acre." (Coleman's European Agriculture.)

It presents a most charming view, with its broad, dark green foliage, and especially in a dry year, when vegetation is parched up all around, it does not show any signs of losing its fresh, living, luxuriant growth. Although of short life, a meadow of this grass may be made perennial by scattering fresh seed over the ground every second year and scratching it with a harrow having sharp teeth. Its unusual ability to withstand the vicissitudes of heat and cold makes it a desirable grass for any thirsty soil, as well as for moist soils. It might possibly be a valuable addition to the soils of the western portions of our state. At least it is worthy of a trial.

Mr. Gould thinks the valuable qualities of this grass may be summed up as follows: "Its habit of coming early to maturity. Its rapid reproduction after cutting. Its wonderful adaptation to all domestic animals, which is shown by the extreme partiality they manifest for it, either alone or when mixed with other grasses; whether when used as green food for soiling, as hay, or as pasturage, in which latter state its stems are never allowed to ripen and wither like other grasses. Its beneficial influence on the dairy, not only augmenting the flow of milk, but improving the flavor of the cheese and butter. Its uncommon hardiness and capacity to withstand for vicissitudes of both wetness and dryness."

PEARL OR CAT TAIL MILLET—(*Pennisetum typhoideum*)—(Annual Hay Grass.)

This is a hardy annual and may be cut two or three times during the season. It grows usually to the height of six or eight feet. It has dense heads, six to twelve inches long and a half inch or more in thickness. The stalks are coarse and hard to cure. When cut before the stalks harden and the seeds ripen it makes a vast quantity of forage that is readily eaten by all herbivorous animals. It requires plenty of heat and a rich soil to bring it to maturity. The experiment made with it on the Centennial grounds in Nashville in 1897 proves that it is a vigorous grower, a gross feeder and a princely looking grass, towering high above all other grasses except sorghum and teosinte. The head resembles a mammoth head of timothy.

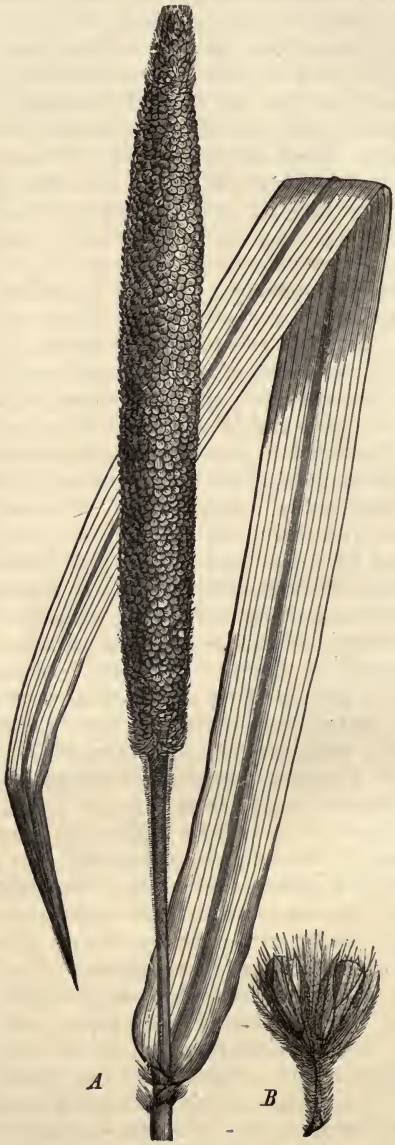
The hay is cured with difficulty, owing to its rankness and coarseness. It requires a great deal of exposure to the sun or air before it can be stored away with safety. It can be recommended as a forage plant on the ground that it makes a large yield at a small cost.

SOILS—The strongest soils only are adapted to the growth of this rank feeder and even these should be heavily manured to secure the best results. Plenty of moisture in the soil is required for its growth and for that reason a dry sandy soil is unfit for its cultivation. A deep calcareous loam or a rich alluvial soil is to be preferred. The rich lands in the loess formation of West Tennessee, the fertile river bottoms of Middle and East Tennessee and the deep soils of the central basin are all well suited to its growth. The rich moist upland valleys of the highland rim deeply plowed and heavily manured will yield large crops of it.

Pearl millet does best when sown in drills eighteen inches apart. The running of a cultivator or double shovel once between the rows is sufficient cultivation to give it. It is a rapid grower and will overlap the rows within three weeks after sowing. About one peck of seed when drilled is sufficient to plant an acre; one bushel per acre is required when sown broadcast. It is a plant very sensitive to cold and it should not be planted until all danger of frost has passed.

Mr. P. Henderson, of New Jersey, gives an interesting account of his experience with it, which is here condensed. He prepared the land by applying ten tons of stable manure to the acre and then plowing it ten inches deep. The seed was sown in drills eighteen inches apart on the 15th of May. After coming up a cultivator was run between the rows one time which was all the cultivation it received. The first cutting was made 46 days after planting. When cut it was seven feet high and covered the whole ground. This cutting weighed green, gave a yield of thirty tons to the acre; weighed after being dried, six and a half tons. The second growth, which was of tropical luxuriance, started at once from the stubble left three inches high at first cutting. The second cutting was August 15th, forty-five days from the first cutting. The height of this was nine feet and it weighed at the rate of forty-five tons to the acre, green, and eight tons dried. The third crop was cut October 1st, which weighed ten tons green and one and a half tons dried. The cool weather of autumn sensibly affected its growth. The aggregate yield from one

sowing was ninety-five tons, in 135 days, of green fodder, which made sixteen tons when dried. It should be cut for hay when the heads first appear.



Pearl or Cat-tail Millet—Pennisetum typhoideum.

As to its feeding value it is about equal to corn fodder. Cattle, horses and sheep are very fond of it both green and dry. It has probably

the largest productive capacity, when grown upon highly manured lands, of any forage crop now grown. While the fodder is coarse it is highly nutritious. The only difficulty is to cure it sufficiently to prevent it from fermenting and moulding. It will grow and flourish wherever Indian corn may be grown. The weight of the seed is fifty pounds per bushel.

MEADOW OAT GRASS OR EVERGREEN—(*Arrhenatherum elatius.*)—(Meadow and Pasture.)

This grass is equally valuable for making hay, for pasturage and for soiling. It produces an immense amount of foliage and its aftermath is about as heavy as the first crop. Having characteristics and adaptability similar to those of the oat, it has been widely distributed in the United States from New England to Georgia. It was introduced into this country from England where it is highly prized for its good qualities. It is a favorite grass in France and the south of Europe generally. It is an object of admiration to all lovers of the grasses, by reason of its great height, its gracefully bending panicles, its purplish anthers, its flag-like leaves hanging in graceful arches beneath the panicle, the green of which contrasts with the purple of the anthers and the violet of the flowering glumes making altogether a rare picture of grace and beauty.

Meadow Oat Grass or Evergreen—Arrhenatherum elatius.
1. Panicle. 2. Spikelet, with the empty glumes removed. 3. Empty glumes. 4. Awned floral glume.

SOILS—This is one of the grasses that will grow best on dry sandy soils, and is a great acquisition therefore to those sections of Tennessee where sandstone soils predominate. It may be grown on the Cumberland table-land with success. Although it prefers sandy soils it will thrive upon any rich, dry, well-drained land. It is a very hardy perennial and will resist equally the heat of summer and the cold of winter. In Southern latitudes it is green throughout the year and hence the name evergreen. In a favorable season two crops of hay may be harvested from the same sowing in one year.

The best time for sowing in the latitude of Tennessee is in March or April, or it may be sown in the fall from the middle of September to the last of October. As this grass has a tendency to grow in tussocks like orchard grass plenty of seed, not less than two bushels, should be sown to the acre.

Mr. Edwin Montgomery, of Mississippi, writes to the American

Agriculturist that many persons in his locality state if they were restricted to one grass, tall meadow oat grass would be the one selected.

Mr. Jared G. Smith, Assistant Agrostologist of the United States Department of Agriculture, says it is one of the best drought-resistant cultivated grasses, but he does not recommend that it be sown alone unless it is grown for seed only. "The forage," he says, "is bitter and is not readily eaten by cattle except where it occurs in small quantities mixed with other grasses. However, the hay is of fine quality and is relished by stock."

It grows rapidly and comes into blossom early. The best time for cutting it is during its period of inflorescence. It likes heat and will grow with more vigor on southern than on northern slopes. An excess of moisture soon destroys it. Well drained lands should therefore be selected for its cultivation. The seed weighs ten pounds to the bushel.

Mr. Sinclair says it is subject to rust in England which does not appear on the blades however, until after its flowering season.

The directions for preparing the soil and the sowing of timothy will apply to the seeding of this grass.

ITALIAN, GERMAN OR GOLDEN MILLET—(*Setaria Italica*)—(Grown for Hay and Soiling.)

This is an annual and is extensively cultivated in parts of Tennessee for hay. It differs from German millet only in having a larger head but less dense. It is considered superior to the common millet and indeed to all other kinds for soiling purposes but not for hay. It grows to the height of from three to five feet on good soils.

Italian Millet—Setaria Italica.
2. Inflorescence. 3. Upper leaf. 4. Spikelet, with two bristles. 5. Spikelet l aid open.

SOILS—Italian millet, like all the millet family, requires a strong, rich, deep soil, sufficiently clayey to retain a large amount of moisture; at the same time the land must be thoroughly drained. It should receive a good coat of stable manure and be well broken in the winter and plowed again in the spring and frequently harrowed, logged or rolled until the earth is fine and lightly compacted. All rank growth of vegetable matter turned under before sowing is decidedly injurious. Such vegetable matter makes the land dry and thirsty and too porous. On land so prepared failures will result in four cases out of five.

A clayey soil in a moist situation, enriched by the application of well rotted stable manure, kept in good tilth, that has been deeply and well

broken the previous winter, and upon which all vegetation has been kept down by frequent plowings or harrowing, are the most favorable conditions for the growth of a large crop of millet. Upon land so prepared one bushel of seed to the acre will be sufficient. The ground should not be dry or wet when it is sown. If too dry many of the seeds will perish near the surface; if too wet the land will be compacted and the crop will "french" or turn yellow. After sowing, harrow well with a light harrow

German Millet—Setaria Italica var.
a, b, Spikelet and "beards," c. Seed.
(U. S. Dept. Agric.)

or run a drag brush over the land, or use a smoothing harrow. Millet may be sown at any time in the latitude of Tennessee from the first of April until the 15th of August. One good soaking rain after sowing will assure an abundant crop. It is a very rapid grower and a rank feeder. It will be ready for the mower within fifty to sixty days after it is sown.

Millet must be cut when it begins to head and before it blooms. To put off the time of harvesting until the seeds are ripe will be to ruin the

hay, for when cut at this stage it is not only worthless for forage or hay but the abundance of seed renders it dangerous for feeding to horses, as it will affect their kidneys in a very marked degree. The hay is cured and treated in the same way as timothy hay but a little more time is required to cure it properly. The less millet is exposed to the sun after it is cut the better will be the hay. The yield of hay on very fertile well prepared land, is as much as three to five tons per acre.

For raising seed run light parallel rows three feet apart and drill the seed with a tin cup or an oyster can having three or four holes punched in the bottom with an eight penny nail. Walk rapidly holding the cup over a row and the seed will be distributed about thick enough. Cover slightly and when the seed germinates and before it comes up run over the land with a light harrow. Cultivate between the rows with a double

Millets.
1. Italian or Common Millet. 2. Hungarian Millet. 3. German or Golden Millet (varieties of Italian.) (U. S. Dept. Agric.)

shovel plow, one plowing being all that is necessary. The millet should be thinned to a mere thread of plants. Cut when the seed is in the dough state with a self-binding reaper. Put the bundles in shocks and thresh when the heads are thoroughly dry. The yield is frequently from 30 to 40 bushels of choice seed to the acre.

Italian millet, and indeed every kind of millet, is very exhausting to the soil, especially if the seed is permitted to ripen.

This grass is of great value to the renter who has rarely the opportunity of continuing in possession of the land long enough to sow a meadow and reap the benefit of it. But for the proprietor who has suita-

ble soils there is no excuse for not providing himself with the best hay the climate and soil can afford, and there are plenty of good grasses to suit almost every variety of soil in the state of Tennessee. If a farmer who is a landowner, wishes to indulge the pride, and it is an economical pride, of having fat horses, sleek cattle, and plenty of bacon, let him at once see to his meadows, for a good meadow is next to a corn-crib to prepare pork for the smoke-house, as well as to fatten all kinds of stock. A crop of millet is a good forerunner for a meadow as it destroys all the noxious weeds, and leaves the land in fine condition for timothy or herd's grass.

Italian millet is sometimes called Missouri millet and Tennessee millet, there being a slight variation induced by differences in soil and climate.

HUNGARIAN MILLET OR HUNGARIAN GRASS—(*Setaria Italica var. Germanica.*)—(Grown for Hay and Soiling).

There is a very slight difference between this and the Italian millet. Botanists regard it as a variety of Italian millet. The head is not so large or long as that of Italian millet, but it is more compact. It was introduced into France in 1815 and is largely grown for forage in that country. It is much relished by horses and cattle and has the capacity of resisting droughts better than the Italian millet. As a hay grass it is probably preferred to Italian millet, both because the head is smaller and the straw is not so coarse. It also cures more quickly and does not grow so rank, nor does it require so much moisture in the soil. It will grow on any soil rich enough to produce good corn or potatoes. If sown after potatoes it yields remarkably well and especially if the land was manured when put in potatoes. Old well-rotted manure is much better for its growth than fresh stable manure. In the management of this grass the same instructions as given for Italian millet must be followed.

Hungarian millet attains maturity a week or ten days earlier than Italian millet sown at the same time. It should be cut when the seed is just beginning to form. Two to three tons of hay to the acre is not unusual. One good rain thoroughly wetting the ground after the seed is sown is sufficient to bring the crop to maturity.

For seed cultivate in the same manner as for Italian millet.

Two or three crops of Hungarian millet can easily be raised from the same ground in one year. A farmer of Davidson county raised a most excellent crop of Hungarian millet, sown the first day of September and cut on the 10th of October. Another, of Williamson county, secured a good crop of German millet sown on the 13th day of August and cut on the 12th day of October. So, if a farmer, by any kind of misfortune, fails in the earlier months to secure a sufficient quantity of dry forage for his stock, he can, as a dernier resort, start very late in supplying himself, by crops of this grass. Should it be desired to use the hay as a green forage, it can be cut three times at least, provided it is done before it begins to throw up the seed stalks. It is a common custom in the southern states to use it in this manner instead of buying the expensive baled hay of the north.

COMMON OR BROOM CORN MILLET—(*Panicum miliaceum.*)—(Grown for Hay and Soiling.)

The heads of common millet are large, open and nodding, resembling broom-corn in general appearance. This grass is used for the same purposes, and cultivated in the same manner and upon like soils, as Italian millet and Hungarian grass. It will yield from sixty to seventy bushels of seed per acre. Cut after the seed is ripe it is valueless as food for any kind of stock.

Broom Corn Millet—Panicum miliaceum.
a, b, c, Spikelet and Chaff. d, e, Two views of Seed.
(U. S. Dept. Agric.)

GAMA GRASS—SESAME GRASS—(*Tripsacum dactyloides*)—(For Hay and Soiling.)

Gama grass merits more attention from Tennessee farmers than it has ever received. It is one of the largest and most beautiful perennial grasses grown in the South, reaching oftentimes a height of seven feet. When young and succulent it is eaten with avidity by stock and makes from its rapid growth a good soiling or forage crop or material for the silo. Its leaves are very large, equal in size to the leaves of Indian corn. It has very strong creeping root stocks, which are as large as those of cane roots, but close grazing will destroy the grass in a few years.

Gama or Sesame Grass—Tripsacum dactyloides.

2. Inflorescence. 3. Base of the female inflorescence. 4. Upper leaf. 5. Male or staminate spikelet. 6. Female spikelet in section. 7. Female spikelet expanded.

Gama grass may be cut three or four times a year and though in its native state it grows in swamps, it will thrive almost equally well on dry or sandy ridges. It will grow where timothy or orchard grass will not, and consequently it is well suited to a large section of our State. The quantity of hay taken from one acre is simply enormous, resembling very much corn-fodder. As a hay it is fully equal to corn-fodder, and it can be saved at one-tenth the labor required to save fodder. It is very nutritious and succulent when cut green. The great mass of roots will serve to open, loosen and improve the land upon which it grows. It should never be allowed to shoot up the seed stem when desired for hay.

It is with difficulty the seed can be made to vegetate and therefore it must be propagated by slips from the roots. Prepare the land well, lay off the furrows with a bull-tongue plow two feet apart, and drop small pieces of root about one foot apart in the furrow, covering with a board. The creeping roots will soon meet, and the ground is quickly turfed with the grass. It should be planted early in September. Of course, the richer the land, whether upland or bottom, the greater the yield. Poor land rarely makes better crops of anything than fertile land. I have seen this grass growing with great luxuriance in Montgomery county, Tenn.

TEOSINTE—(*Euchlœna Mexicana*, *E. luxurians.*)—(Grown for Fodder.)

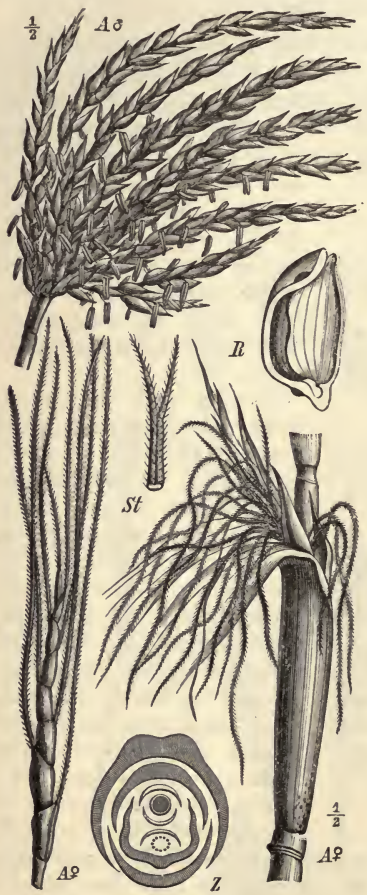


Fig. 32.

Teosinte—Euchlœna Mexicana, E. luxurians.

The uppermost cut in the figure shows the male inflorescence reduced one-half; to the right below is shown the female inflorescence mostly concealed within the sheathing leaf; to the left below is shown a single female spike. *R.* A joint of the rachis of the female spike. *St.* Terminal portion of the stigma.

This is an annual grass and in the luxuriance and largeness of its growth it much resembles Indian corn. It attains a height upon fertile soils of from eight to twelve feet. It is of tropical origin and was introduced into the United States probably from Central America or Mexico, or from both.

It has been successfully grown at the Experiment Station at Knoxville, and is regarded as one of the most prolific forage plants known to agriculture. Stock is very fond of it, and it will yield twenty or more tons of green forage per acre. It will bear cutting several times during the year but some authorities believe that the best results will be obtained from a single cutting just before frost. It tillers greatly, as many as fifty stalks having been observed as springing from the same root. The Agricultural Department at Washington recommends that teosinte be planted in drills three feet apart and thinned to a foot apart in the rows. One pound of seed is sufficient to plant an acre. One drawback to this grass is that it does not mature its seed in Tennessee, and very rarely north of Southern Florida.

The soil for its growth must be deep, moist and fertile. Any soil suitable for corn will produce teosinte. It is one of the rankest feeders of all the grasses. Dairymen living near a city would find it valuable as a soiling crop for cutting green and feeding to milch cows. The stalks are very tender and are eaten greedily by cattle, whether green or dry.

It is a difficult matter to cure this grass properly and many other grasses adapted to the soils of Tennessee are to be preferred to it for making winter feed for stock. It may be cut with corn knives in the fall

and set up in shocks. It has very little, if any advantage over corn when the latter is cut and put up before the blades are dry. Teosinte harvested in the same way would probably have its greatest value and be most easily saved at the smallest cost for labor. It is superior to corn as a forage crop only in its capacity of giving a greater yield.

Teosinte—Euchlæna Mexicana, E. luxurians.

Showing its robust character and habit of throwing up many stalks or culms from a single root.

SUGAR SORGHUM—CHINESE SUGAR CORN—(*Sorghum saccharatum.*)—(Hay, Pasture, Forage, Silo and for the Manufacture of Syrup.

Fifty years ago sugar sorghum or Chinese sugar-corn, was unknown in the United States. It is now grown to a greater or less extent in every southern state, all through the western states and as far north as Pennsyl-

vania and New York and even in Canada. At first it was grown only for the manufacture of syrup. It was soon discovered, however, that stock of all kinds ate it with a decided relish and that it kept them fat. About 1880 it first began to be grown in Tennessee as food for cattle. It is now grown extensively for forage in every part of the State and by many farmers it is regarded as far superior to corn fodder for feeding cattle. It certainly abounds in fat-making elements. The seed in India and in other tropical regions is largely employed by the inhabitants as food and it is asserted by high authority that more people subsist upon it and kindred species than upon any other cereal. While wheat makes the best bread, sorghum seed, Kaffir-corn, Durra-corn and other like species can be produced cheaper and is the chief "staff of life" among the poorer classes in the Orient. In Tennessee the grain has rarely been employed for human food, but it has been fed to all kinds of live stock and it is especially valued for feeding poultry.

Seedhead of Amber-Orange Sorghum. (U. S. Dept. of Agric.)

VARIETIES, SOILS AND CULTIVATION.—There is a vast number of varieties and sub-varieties of sorghum. Originally there were two leading kinds, the Chinese sugar cane and the Inphee, known as the red and the black, or the Chinese and the African. For the manufacture of sugar, probably the Inphee cane is superior, but for the manufacture of syrup, the Chinese is preferred. These varieties have been modified by cultivation and climate and from them have originated several that are regarded for specific purposes much better than the two great original varieties. The variety called amber is most widely distributed and is used for forage purposes in almost every state where sorghum is cultivated. What is known as the early amber is used both for forage and for pasture. The *amber variety* is very sweet, very early, not very rank and therefore is better adapted for making a coarse kind of hay. The orange varieties are said to come next to the amber varieties in point of popularity and usefulness. These are coarser than the amber varieties. They do not grow so rapidly or mature so quickly and are therefore not so much used for early feeding or for hay. They are said, however, to be better for soiling purposes and for the silo. Other varieties are known as Folger's early, Coleman and gooseneck. For summer pasturage, Folger's early is said to be an excellent variety.

Sorghum will thrive to some extent on the poorest soils. When the earth is parched up by drought it maintains its fresh, green color and continues to grow. However, it will thrive better on rich, calcareous and alluvial soils, and though the juice may have more water, when grown on such soils it will make far more syrup. The roots of sorghum penetrate the soil deeper probably than any other cereal and consequently deep plowing in the preparation of the soil is highly important to make a full crop. Not only should the plow be used, but the subsoiler also. On

good land it grows to a height of 15 to 18 feet; on poor, badly prepared land, it stops at five or six feet. Because it will grow on poorer land than other plants is no evidence that poor land is better for it. On gravelly or sandy subsoils, the roots will go four or five feet deep, and on this kind of land, if rich, it will make far more syrup and of a better quality. For syrup making it should be planted in drills three feet apart. In four or five days the young and tender plants come up, looking very much like

Seedheads of Sorghum—Collier variety, one of the best.
(U. S. Dept. Agric.)

grass. Young sorghum grows rapidly, and soon outstrips the weeds. When three or four inches high, it should be chopped and thinned out, and but little more work need be done to it. Two or three plowings are all it should receive, as the roots penetrate the ground so thickly the plant will receive more injury than benefit if plowed after it is three or four feet high. Besides, by that time the ground is so shaded by lateral branches and suckers that the weeds will effect no material injury.

Much difference of opinion existed at first, and still exists, as to the best time of cutting so as to get the largest amount of good syrup. Some assert it should be harvested when the seeds are in the milky state, others when they are fully matured. A slight degree of frost does not injure it, and this has caused the loss of many a crop, for whenever it freezes, fermentation ensues, and it will not make syrup at all; or if it does it is black and has a disagreeable odor. But repeated experiments have demonstrated the fact that early cut cane makes the best and cleanest molasses.

AS A FORAGE AND SOILING CROP—But it is rather as a forage crop that the methods of cultivating and curing this plant properly belong in this bulletin. Its uses are almost as various as those of Indian corn itself. As has already been stated, it is greedily eaten in all stages by stock of every kind. The seeds are abundant and one acre of good sorghum will make from forty to sixty bushels of seed. The heads can be cut from the stalks and stored for use, taking care to spread them out until they are dry, when they make good food for cattle, horses, sheep, hogs and poultry. When ground into flour they make good bread. Both the seeds and the expressed juice have been extensively used in distillation, large quantities of alcohol and sorghum brandy being annually made from them. During the civil war it formed almost the only resource of the South for whisky, all other kinds of grain being in too much demand for distillers to use them.

But probably it possesses more good qualities as a green soiling plant than any other. Let it be sown on good land, either broadcast or thickly drilled with a seed drill, from April to July, with about one bushel of seed to the acre, and the amount of forage will be immense. It will yield from 20 to 30 tons of green fodder to the acre, which, when dry, will make four to six tons of the sweetest and best of hay, and stock will eat up the last vestige of it.

HARVESTING AND CURING—The most difficult thing in connection with the growing of sorghum for hay, is to cure it properly. When sown broad-cast upon a rich soil using three bushels or more of seed per acre or when drilled with a wheat drill using a like amount of seed, it makes such a rank growth that it is a troublesome task to cut and save it. If the seed is sown thick enough so that the stalks will be small, the crop may be cut with a mower. If the stalks are large, a corn knife will have to be used or a corn harvester. Some farmers use the self-binder in cutting the crop but in this case the height of the stalks must not be over five or six feet.

The proper time for cutting is when the heads begin to flower. Then it should be cut and bundled as corn fodder, or it may be left spread on the ground, if the weather is good, for several days, and it will be dry enough to store but not in too large a bulk. Its stems are so full of juices that it will not cure quickly. The juices in it, however, will sugar in a few days when it will keep as well as timothy. It possesses fattening qualities in an eminent degree and nothing like it was ever used for improving a drove of mules. If the farmer has a drove of mules or herd of cattle or milch cows or flock of sheep it can be fed to them from the time

it is two feet high and they will eat it with avidity. By the time a field is gone over, it will be ready to cut again, as the root freely throws up new suckers and will continue to do so until stopped by the frost. Thus, as many as three crops of it, if sown early can be cut in Tennessee as a soiling crop, before it is destroyed by the cold. Or if it is not wanted as

Sorghum Growing on the Station Farm, University of Tennessee.
(U. S. Dept. Agric.)

green forage, it can be cut at blossoming for hay, at least twice without resowing. And the second crop will be as good as the first.

After lying on the ground for three or four days it may be gathered and shocked like corn, if the stalks are large, but if they are small they

may be raked up and put into cocks from which, after remaining for a few days, the hay may be hauled to a shelter or put into stacks and topped off with fodder, rye straw, herd's grass or timothy hay. It will be necessary if the crop is very rank to turn it over on the ground so that all parts of it may, as far as possible, be equally exposed to the sun.

The difficulty of curing is greatly increased during rainy weather, as under such a condition the stalks are apt to blacken and ferment. Some farmers find the best way to preserve it from fermentation is to make alternate layers of sorghum and dry wheat straw, the latter readily absorbing any undue moisture which may remain.

For a long time the farmers objected to growing it extensively because they believed it to be a very exhaustive crop to the soil. This is true when the seeds are permitted to ripen fully. In fact the experience of the writer is that if left to ripen seed it exhausts soils more than the growth of corn or wheat. But when sorghum is cut just as the head begins to blossom and before the draughts are made upon the soil for maturing the seed, it injures the soil less than probably any other crop yielding as much forage. In many parts of Tennessee where there are fields well suited for the growing of sorghum the same land is planted with it for several years in succession without showing any diminution in the quality or quantity of the forage produced. It is claimed by some observant farmers that the land is benefited by the deep growing roots through their agency in permitting the soil to be thoroughly aerated. Very little injury is done to the soil by removing the crop in an early stage of development. Many farmers claim that when planted late with cowpeas or other field peas and cut before the seeds are matured, the land is left in excellent condition.

Mr. Bulow, of South Carolina, in speaking of sorghum, says:

"I rely almost entirely on early amber sorghum as forage for my sheep and cattle. I cultivate it in three-foot rows and sow the seed rather thick. About the time the heads begin to get hard, cut and put up in shocks and bind tightly at the top and it can remain in the fields for three or four days, as we have but little rain during the fall months."

Mr. Thompson, of Georgia, says:

"Sorghum makes good roughness. Plant thick in the drill, cultivate it, cut it and shock until cured. Make the shocks small; when partly cured put two to four together. Sow about one and one-half bushels of seed to the acre and mow and cure like millet."

In Texas the hay is often baled from the cocks after giving it an additional exposure to the sun for several hours. The experiments made at the Texas Station show that the percentages of fat and protein increase as the sorghum ripens, but when ripened it is not so digestible, so that the increase in fats and protein are more than off-set by the indigestibility of the forage.

Georgia experiments show that the highest percentages of fat and protein are found in the plant when cut during its inflorescence. Unquestionably the consensus of opinion with a large majority of farmers is that it makes the best forage when cut in bloom. The yield often runs as high as 12 to 15 tons from one sowing. As a food for milch cows it is

unexcelled on account of the large flow of rich milk, which it induces. Care should be taken at first in the feeding of the green forage to cattle unaccustomed to it. They should be restrained and not suffered to take a full feed, as it is very succulent and like clover, is apt to induce hoven.

AS A PASTURE—As a pasture grass sorghum has been highly commended. The Arkansas Experiment Station issued a bulletin in August, 1896, in which it is stated that sorghum gave excellent results as a hog pasture used in connection with clover and Spanish peanuts to give a succession of fresh food. Sheep, hogs and milch cattle are especially fond of it. For a pasture it should be sown very thickly and it is a wise policy to sow two or three fields or parts of fields separate from each other in sorghum and pasture them alternately. Sorghum grows so rapidly that as soon as the stock is taken off one field it will, within a week be ready to pasture again. Tennessee farmers would find it greatly to their interest to break up portions of their stubble fields when a catch of clover has failed or been destroyed, and sow in sorghum for a late summer pasture. The capacity of this plant to resist drought makes it especially valuable for pastures at a season when clover, blue grass and orchard grass and all the best pasture grasses have fallen off or become exhausted in their grazing capacity by reason of the summer's drought. I know of nothing that will so well fill up the gap between the spring pastures and the fall pastures as sorghum sown upon wheat stubble from the latter part of June to the last of July. Farmers should try it.

SORGHUM FOR THE SILO—Director Redding, of the Georgia Experiment Station, regards sorghum as a material for ensilage quite satisfactory. He says: "For the silo I consider the three most valuable plants in order, are Indian corn, cowpeas and sorghum." Notwithstanding this favorable estimate of the value of sorghum for the silo many object to it on account of its tendency to become acid. It also lacks the nutritive quality of Indian corn and unless cut very early in its growth the stalk becomes so hard that it is not eaten with comfort by cattle. One advantage, however, of sorghum is that it will remain green in the fall for a much longer time than corn and so a larger quantity of it may be utilized for making ensilage. When it is grown in conjunction with cowpeas or soy beans it gives a much more nutritious ensilage than corn taken by itself.

With all the short-comings of sorghum it must be regarded as one of the most useful and widely cultivated plants that has ever been introduced into the United States. Among the small farmers it is highly prized for its syrup-making properties. Among stock-breeders it is valued because of the immense amount of forage which it supplies at a small cost. It has the capacity to resist dry weather better than almost any other crop. It may be used for more purposes than almost any other crop. It is very valuable as a pasturage for sheep, hogs, cattle, mules and horses. It makes good hay for winter feeding. The seed is said to be worth, for feeding purposes, about 90 per cent. as much as corn. The hay is better than corn-fodder and the stalk when properly cured may be reckoned among the best fattening foods grown.

JOHNSON GRASS—(*Andropognon sorghum halepense.*)—Meadows and Pasture.

Space for a description of Johnson grass is given in this bulletin mainly for the purpose of warning Tennessee farmers against it. While it makes excellent hay and furnishes a large amount of grazing it is at the same time one of the most troublesome weeds that can be introduced upon a farm. If one wishes to raise nothing but hay; if he has no regard for the rights of his neighbors; if he expects never again to grow tillage crops on his farm, then the wisdom of sowing Johnson grass may be commended. Otherwise it should be left severely alone for no time will completely eradicate it when once well set upon good land. It has a thick fleshy root stock that penetrates the soil in every direction and throws up a culm from every joint. If a single piece of root an inch long is left in the ground it will be the prolific mother of a numerous progeny of stalks and roots within a year. It is possessed of a strange and extraordinary vitality. A barrel of salt poured upon a bed of it eight feet square did not destroy the roots. Within a month the salt disappeared, leaving a briny surface, but the invincible roots sent up an army of numerous stalks that waved their flags in victory over the bed that was intended to be their grave.

Johnson Grass—Andropognon Sorghum halepense.

The only possible way to keep Johnson grass in subjection, so far as the writer knows, is to pasture it with hogs and never suffer the grass to go to seed. Frequent plowing of the land and bringing the roots to the surface so that the hogs may find them readily will assist in keeping it down. One of its greatest virtues is that hogs will thrive upon its succulent roots which they seem to prefer even to artichokes. They never tire in searching for them.

SOILS—Rich, well drained, calcareous soils and especially rich alluvial soils will grow this grass most luxuriantly, but it will thrive on a sandy dune, in a barren field, on a rocky ledge, wherever it can find a handful of dirt, and it will even flourish in the bottom of a gully. It knows not how to fail. In a southern climate it will grow on any spot and will resist the severest droughts, withstand the coldest weather of southern winters, and make a vigorous growth where but few other plants

will live. It is in a sense the most self-assertive of all the grasses and like the wild garlic will propagate itself equally as well from the roots as from the seeds.

With all its bad qualities it is probably the most prolific perennial hay grass in the United States. In the latitude of Tennessee, Northern Alabama and indeed throughout the South, it may be mowed three to four times a year and will yield at each mowing from two to three tons of excellent hay when grown on rich soil. The best time for cutting it to make hay is before the heads appear. After the seeds are formed the stalks grow hard, which makes the hay unfit for stock. Jno. B. McEwen, of Williamson county, a most observant farmer, speaks in rather extravagant terms of the quality of hay made from this grass and declares that it is the best hay he makes on his farm.

When young, Johnson grass is very tender and sweet and the pith is filled with sugary juices. As a soiling crop it is very much prized, as it may be cut every month from May until heavy frosts. Dr. Phares, of Mississippi, says during a long drought it was mowed in the northeastern part of that state three times and on the first of October there was a growth from eight to twelve inches high. Upon this cattle were turned and there remained feeding and fattening on the abundant, rich, rapidly growing foliage to the last of December.

All writers on this grass, with the exception of a few who live above the 37th degree of north latitude, while commending it highly for the fecundity of its growth and the nutritious qualities of its foliage and roots, speak of it as utterly ineradicable. Prof. Gulley, of Mississippi, says in the quantity and quality of hay it stands first for permanent meadow, especially if sown on rich, well drained, heavy land. Prof. S. M. Tracy, says: "Johnson grass makes excellent hay and will give from three to four cuttings a year. While thousands of dollars have been made by its cultivation and it grows well on almost any kind of soil, it will never be popular, as, when once planted 'it sticketh closer than a brother,' and it is difficult to grow any other crop on the land."

When the roots become thoroughly matted in the soil the yield of hay decreases. A good plowing of the ground so as to dislocate the masses of roots will start the grass to growing again in all its tropical vigor. As a meadow or pasture grass it will retain its hold upon the land and suffer no inroads whatever by other grasses or weeds. The only situation it cannot endure is when sown where it will be overflowed and the water left standing upon the ground. Under such conditions the roots will rapidly decay.

The seed weighs 35 pounds to the bushel and one bushel is required for sowing an acre. It may also be propagated by setting out pieces of the roots a foot apart.

The writer, however, wishes to emphasize and repeat his warning to the farmers of Tennessee: Never plant Johnson grass with the expectation of destroying it for it is a "stick-fast" and will survive the roughest treatment. Many excellent valley farms in the central basin of Middle Tennessee have had their value greatly decreased by the presence of this unconquerable grass.

Indian Corn—Zea Mays.

Botanical Description of Indian Corn—(Zea Mays, L.)—In the center above is single stalk, reduced to 1-10th its natural size, showing the terminal male (the "tassel"), and in the axil of the third leaf from the base is the female inflorescence enveloped in broad, leafy bracts. At the base of the figure on the right side this female inflorescence is shown more clearly; the hair-like tuft is formed by the projecting slender styles (the "silk.") To the left at the base of the figure is shown an "ear" of corn, the kernels being the matured ovaries from which the styles have disappeared. In the upper left-hand corner of the figure are two spikelets. The flowers of Indian corn are unisexual, the one male or staminate, the other female or pistillate; both are born upon the same plant, but each is in a separate inflorescence.

INDIAN CORN—(*Zea Mays.*)—(For Forage).

Taking it in all its manifold uses there is no other product of agriculture grown in America so important to man and to domestic animals as Indian corn. The grain is more extensively used in the United States than all other grains combined. The average annual crop does not fall short of two thousand million bushels. The oat crop which comes second rarely surpasses 800,000,000 bushels. The corn crop has always been a leading one with the farmers of Tennessee from pioneer days to the present. In fact, in 1840, Tennessee grew more Indian corn than any other state in the Union.

It is not the purpose of this bulletin, however, to try to teach Tennessee farmers how to raise corn or to go into an elaborate description of the great number of varieties produced in the United States. The chief object of this paper is to direct their attention to the value of Indian corn in the making of hay and forage. The "saving of fodder" was for nearly a century considered one of the indispensable tasks of the farmers of Tennessee, but no one in early times ever thought of sowing Indian corn and mowing it to supply the place of fodder. The dairymen of the north have, for many years, been using corn so sown as a soiling crop for their cows during the dry months of July and August after the first pastures have dried up and before the fall pastures have become green with the latter rains. A vast amount of forage in the form of fodder tops and stalks is saved in every part of the United States. Even in Europe corn forage is growing to be very popular, and the grain is now used by the inhabitants of many foreign states who knew nothing of it thirty years ago.

Mr. Mechi, who for a long time enjoyed the distinction of being one of the best farmers in England, placed a very high estimate upon corn fodder not only in the feeding of sheep and cattle, but for the production of milk and butter. He estimated that one ton of such fodder is equal to forty bushels of grain.

There is a class of small farmers and tenants in the State of Tennessee who do not own the land which they cultivate. These farmers must raise some kind of hay, or as they call it "roughness" with which to feed their work stock. This can be easily done by sowing, the first of May upon well prepared land, a few acres in corn at the rate of a bushel and a half to the acre. It should be covered with a harrow. The corn fodder will mature in about 90 days, that is to say, it will arrive at that stage when it should be cut, which will be about the time the tassels and silks are well developed. Cut at this stage, it will make from 40 to 50 tons of green forage on an acre of fertile land and from three to four tons of dry forage. It makes also an excellent soiling crop for milch cows.

There is some difficulty in curing corn-fodder properly, as it is extremely succulent. It must be cut in good weather and spread evenly on the land so as to receive as much sun as possible. It may then be put up in shocks like hay, after it has been sufficiently dry to escape the danger of fermentation. It may be managed very much in the same manner as sorghum. Corn fodder, green, is also an excellent material for ensilage, especially when grown with cowpeas, oats and soy beans.

There is a small variety of corn known as Dixie corn, the ears of which are not larger than the fingers. This corn usually yields from six to eight and even as high as fifteen ears to the stalk. The grains are very small and the corn matures quickly. If this corn should be sown upon rich land and cut at the time the grains are in the dough state, it would make a mass of forage highly nutritious and would serve the purpose of both grain and hay. The stalks are so small that they may be cut with a reaper or mower and put up in the same way as the corn shocks of ordinary corn when cut in the fall. The sowing and saving of this Dixie corn for forage deserve the consideration of Tennessee farmers. Stubble land could be employed for the growing of this crop.

CRAB GRASS—(*Panicum sanguinale.*)—(Hay and Pasture.)

This is a hardy annual grass, attractive because of its digitate form of inflorescence. It is indigenous to the soil and troublesome in the cultivation of other crops when clover or peas have not been used in the systems of rotation. In the early settlement of Tennessee it was far more abundant in the cultivated fields than at present. This grass comes up spontaneously. It grows with the greatest luxuriance upon stubble fields and in cornfields in low situations. It makes an excellent pasture from June until October in the latitude of Tennessee and even to a later date when heavy frosts do not occur. Its most intimate associate is green foxtail (*Setaria viridis*), which is totally worthless when it begins to seed. Crabgrass is never sown. When cultivation ceases it takes possession of the land. It is justly regarded as an excellent pasture grass but it forms no sward. It sends out numerous stems, however, branching at the base. Crab grass serves a useful purpose in stock husbandry all over the south. It comes on at a time when northern farmers are compelled to resort to soiling crops in order to supply green food to their milch cows. A dairyman from Ohio said to the writer upon seeing a field of crab grass growing to the height of three feet, that it was the most valuable summer grass for the dairy he had ever seen. It grows very rank after oats and, cut when in flower, often yields more forage than the oat crop that precedes it. Sometimes as much as two tons of crab grass hay to the acre have been cut within forty days after the oat crop has been re-

Crab Grass—Panicum sanguinale.
2. Upper leaf and inflorescence. 3. Portion of one of the racemes. 5. Spikelet, front view. 6. Spikelet, side view.

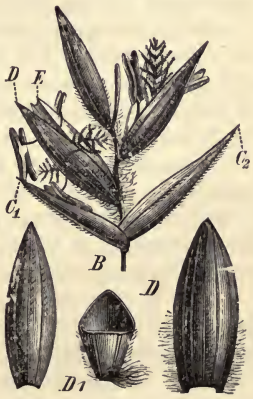
moved. The hay is sweet but light, and stock seem to prefer it to any other when cut early before the seeds harden. It will not shed rain very well and it should be cut during a dry spell. It cures rapidly and unless very rank it may be hauled in and stored away the next day after it is mowed. It may be stacked in the open fields but the stacks must be capped with herd's grass or timothy hay. The hay is sometimes gathered by pulling it up from between the corn rows. This is a tedious task but not more so than the pulling of fodder. Crab grass furnishes more hay for home use in the Gulf states than any other grass. It is usually cut in August or September, and even as late as October.

Mr. Sinclair says that the clean seed, when boiled in milk, makes a dish resembling sago. It has been used as a substitute for sago in Germany, and is really cultivated for that purpose in some districts.

BLUE GRASS—JUNE GRASS—(*Poa pratensis.*)—(Pasture Grass.)

This is a perennial grass and is well styled the king of all the pasture grasses. It is very choice, however, in the selection of soils and situation.

Kentucky Blue Grass—Poa pratensis.
2. Panicle. 3. Upper leaf. 4. Spikelet. 5. Empty glumes.



Spikelet of Blue Grass, showing seed.

Wherever it plants itself the land advances rapidly in price and it becomes the breeder's ideal home. Blue grass indeed has no rival within the limits of its growth. All other grasses that make inroads upon its territory are regarded as intruders. Whoever has blue grass is possessed of the key to fortune. Stock breeders depending upon other grasses may do well. The stock breeder in the blue grass region can hardly fail to do well.

SOILS—The best blue grass soils in Tennessee and Kentucky are the calcareous loams of the Trenton formation. In Tennessee these soils prevail in the central basin. There are parts of East Tennessee, where the Trenton limestone abounds, that will also grow blue grass well.

Even upon some of the foot hills of the mountains, as well as in the valleys, thick blue grass sod is often met with. Among the limestone hog-back ridges in that region, and especially in Southwestern Virginia, are found some of the best blue grass pastures of the South. Blue grass may be successfully grown upon the more fertile lands of the highland rim, particularly in those localities where the St. Louis limestone abounds. A singular fact in connection with the heavy clay soils of Montgomery, Robertson and Stewart counties deserves mention. When the lands are first opened to cultivation, the soils seem adapted to the growth of blue grass. Tramping however, soon destroys it. After being in cultivation for a few years so as to destroy a large part of the original humus, it seems to reach a condition, a second time, favorable for the growth of blue grass. All old fields thrown out of cultivation in these counties soon show considerable areas covered with blue grass. In the digging of an ice house many years ago on the writer's farm, the red clay was thrown out and a mound made of it around the superstructure. Blue grass after a few years appeared and is now growing in vigor upon this clay. The presence of locust and walnut trees always induces a growth of blue grass on any soil clear of underbrush. West Tennessee has some blue grass lands in the tier of northern counties where limy concretions abound in the soils. It is also successfully grown in the yards in many other parts of that division of the state.

Good blue grass pastures, however, are rare in Tennessee outside of the central basin. The best soil for its growth is strongly impregnated with the carbonate and phosphate of lime, potash, alumina, ferric oxides as indicated by the reddish color of the soil, all associated with a large content of humus. Commingled with the soil are small angular pieces of limestone gravel to the extent of twelve or fifteen per cent. The alumina in such soils varies from 15 to 30 per cent., though the subsoil is often porous. Blue grass sown on such soils is benefited by being tramped The foundation of all these soils is a soft calcareous limestone belonging to the Trenton period.

Blue grass is not so highly prized for pastures in England as it is in the United States. Doubtless its nutritious qualities are there impaired by the extreme humidity of the climate, notwithstanding Mr. Sole, of England, calls it "the most noble of all the grasses for agriculture." It produces nearly all its flowery stems at once and when the seed ripens and the stalks decay a wealth of blades spring up and falls over in great folds which furnishes an immense amount of grazing. Its aftermath is more valuable than its first growth. Blue grass is rarely injured by cold weather, by close grazing or by the tramping of stock. It bears a drought heroically. Though it may look brown and sere after a long dry summer, the first autumnal rains will start it afresh and in a few days its beautiful leaves will clothe the earth with a rich mantle of verdure.

Blue grass requires three or four years to become well established. It should be grazed but lightly during this period. After it has grown into a good thick sod close grazing will not hurt it. When eaten down to the ground in favorable weather it will reproduce itself in a few days.

The early spring growth, by its succulence, greatly increases the flow of milk but it does not add materially to its richness. As the summer advances the quality of the milk grows richer and its capacity for butter-making increases.

HOW AND WHEN TO SOW IT—If a wooded lot has been selected for seeding to blue grass, all leaves and trash and underbrush should be removed. The seed must come in contact with the soil. Sown on a bed of leaves the seed will germinate during moist weather but under such conditions the rootlets will soon wither and die. The timber trees should be thinned out if standing very thickly upon the land. At least one-half or two-thirds of the area should have unobstructed sunshine during a portion of the day. The tallest and best timber trees should be left and the bushy trees should be removed. Blue grass does better when subjected to the cool of the shade during a part of the day.

So many seasons have been recommended as the best time for sowing blue grass that it may be said each one, under favorable conditions, is a good one. One Kentucky farmer says: "Any time in the winter, when snow is on the ground, sow broadcast from three to four quarts of clean seed to the acre. With the spring the seeds germinate and the sprigs of grass are then very fine and delicate. No stock should be allowed for the first year, nor until the grass seeds in June for the first time, which will be in the second or third year. The best plan is to turn on your stock when the seeds ripen. Graze off your grass, then allow the fall growth, and graze all winter, taking care never to feed the grass too closely at any time."

Another authority says: "Follow nature and obey her dictates. The seeds ripen in June and are scattered by the winds and rains as soon as ripe and therefore, sow your seeds as soon as they can be gathered."

This plan might be a proper one in a colder or moister climate than that of Tennessee but here it would result in the grass being often killed by the droughts that come almost invariably in the latter part of summer. Many sow on winter snows, which is a very good method, but care should be observed to have the ground free from leaves before the snow falls.

There are others who sow in the latter part of February or first of March. This season does as well as any provided the grass gets sufficient hold to resist the withering effects of the summer's drought. The main point is to get the grass large enough to resist successfully the frosts of winter or the droughts of summer. It can endure frost better than heat and this fact justifies the statement that the most approved time of sowing is in the latter part of August or first of September. If sown at that time the autumnal rains will cause the seed to germinate quickly and the grass to grow rapidly. At this season there is comparatively little trash on the ground, the leaves having not yet fallen. The ground being prepared the seed is sown broadcast, at the rate of one bushel of seed in the chaff per acre. The sower should be followed with a harrow, or if the ground is very loose with a stiff brush and roller. This will give the seed a sufficient covering. Blue grass seeds will vegetate best when put at a depth of one-quarter of an inch. It may be supposed that, with no more

covering than will be given by a harrow or brush, a great many seeds will be left uncovered. This is true but in one pound of blue grass seed (clean seed) there are 3,888,000 seeds. By a computation every square inch of surface will contain from nine to ten seeds. With this amount on the surface, one scarcely need fear a stand, when if one or two take root there will be a close turf in a year upon good soils.

Dr. F. H. Gordon, of Smith county, who during his life paid more attention to the growing of blue grass than any one else in the State, adopted a plan of management that has been repeatedly tested, with uniform success. It was this:

He sowed, either in the autumn or spring months indiscriminately, as suited his convenience. He usually sowed with rye, wheat or barley if sown in an open field, but if in a woods lot, the blue grass was sown only with rye, or after a crop of millet. The soil was cleared of all trash and brush, and broken up as well as the nature of the land would permit. The grain was first sown, the land harrowed and if possible rolled. After this, the grass seed was sown over the ground and brushed lightly. Cattle, horses and sheep were then turned in, as many as could be secured. If there were not enough on his place he borrowed his neighbor's stock, and let them run on the land until it was well packed all over the surface. If sown after millet (and that is greatly recommended, as millet destroys, more effectively than anything else, all weeds) the land should be harrowed about the first of September thoroughly, the seed sown and brushed in. After this the stock should be turned on the land. If it is desired to sow the grass in the spring, during the latter part of February or early in March, if not practicable sooner, the grain field should be harrowed, the ground having been well prepared in the fall. The seed is sown and stock turned on the wheat, rye or barley as the case may be. Oat land may be sown in the same way. The treading of the stock packs in the seeds and prevents the grass from drying up in summer or freezing out in winter. Dr. Gordon considered an open, loose porous surface, extremely unfavorable to the safety of the young grass. When packed as directed, the grass will quickly spring up and get a firm hold, and the loose condition of the subsoil will favor the transmission of the roots to a good depth.

Dr. Gordon would not permit the grass to seed at all. His great success in this branch of agriculture gives weight to his authority. Others, who have been successful in managing blue grass think no stock should go on it for two years, or at least until after the first seeding, which will take place in June of the second year. Some of the best blue grass lots in Middle Tennessee have been started by following either of the methods given above. The ground should not be well broken up. The surface should be as firmly packed as possible in order to secure a perfect stand and to form a perfect turf. When the surface is loose, the grass dries up in summer and freezes out in winter. With favorable weather, seed sown in the spring on a crop of oats will do as well as fall sowing. What is meant by favorable weather, is that no unusual dry weather supervenes. But the risk of meeting with unfavorable weather in spring sowing is great, and for this reason fall sowing is preferred. The sowing should take place as early in the fall as the weather will permit, or indeed in the

latter part of summer, if there is a proper degree of moisture in the soil. Some sow a limited amount of seed daily and over the same surface sprinkle shelled corn and then turn on their hogs. The hogs root in search of the corn and thus plant the seed, doing the work of plow and harrow. This, to say the least, is a slovenly way, and though possibly insuring a good stand, the ground is made so rough it can never make a beautiful pasture until worn down.

If the land is loose as some soils are, it will answer a very good purpose to simply scratch the surface well with a sharp toothed harrow, and this is especially to be commended where there is a large number of roots in the ground.

AFTER TREATMENT—A blue grass pasture must not be pastured to death. It will stand almost unlimited grazing, but there is a point beyond which grazing will cease to be profitable. That limit should never be passed. The better method is to have the field divided into lots and allow the stock to run on one lot until it is cropped down, and then the stock should be removed. No good purpose is served in letting stock run on a lot in which there is no grass. It will not only do the stock no good, but by constant tramping, the grass will be unable to throw up any foliage. Under such treatment the roots will frequently perish. Time should be given for the grass to recuperate by changing the stock from one pasture to another, and never permitting it to be overstocked. Grass that will keep ten oxen in growing order, will fatten five oxen quickly. Stock of all kinds are constant feeders and there should always be forage enough to enable them to get plenty to eat without the labor of hunting for it.

There is much variety of opinion as to the amount of stock that ought to be put on an acre. This arises from the difference in the capacity of the land to produce grass, the character of the season and the nature of the soil. Porous soils will stand much heavier grazing than compact soils. It is better to err on the safe side and it is wiser to put on too few than too many cattle. If stock are fattened quickly, they are more remunerative than when fattened slowly. Ordinarily two acres of good grass are sufficient for one three year old ox and what will fatten one ox of that age, will fatten ten head of sheep. Some think that blue grass should be allowed to go to seed once or twice or until the ground is well set or turfed over and then never again. It is a grass that propagates itself mainly by its creeping roots or rhizomes after the first sowing, and it is the disposition of all plants and animals to lose vitality in the process of reproduction. It lies dormant for a time after a full crop of seed. It is to be doubted if blue grass should ever be allowed to go to seed after the first time.

The grass sometimes becomes so dry that it will burn. Stock will, however, eat it, ravenously, in that condition. The grass having dried full of nourishing juices, it is equal to the best of hay, and stock will fatten upon it, unless the dried grass has been drenched with rain.

The fall growth of some lots should be kept untouched by stock so as to have a good winter pasture. The grass will grow high enough to fall over and protect the surface foliage. In this condition stock will

PASTURE ON UNIVERSITY OF TENNESSEE FARM.

keep up their flesh when permitted to run on it during the winter months without other food. When snow falls, however, cattle will have to be fed, but horses, mules and sheep will paw off the snow, unless it is too deep and get at the grass. It is the first grass that puts forth its leaves in the spring. Good fat lambs can be sent into the market earlier than from any other grass. It makes milk rich in butter, and gives the latter a fine golden color without injuring its taste, or, like clover, imparting its peculiar flavor to it.

While blue grass is the most valuable of all grasses for those portions of Tennessee where the soils are adapted to its growth it is too true that many farmers living in those sections show a total indifference concerning its cultivation. A farm well set in blue grass will yield a return per acre of from $10 to $15 for grazing purposes alone. With such profits from its growth it would seem that every farmer in the state would hasten to sow it. Many do not because they are unacquainted with the best system for its management. In its nutritive elements it ranks very high. Recent tests show that while timothy contains 4⅓ per cent. of albuminoids; orchard, 6½ per cent., red top, 6⅔ per cent., blue grass contains 8 per cent. These results vary with grasses grown on different soils, time of harvesting and methods adopted in curing.

A standard bushel of seed weighs 14 pounds.

It is the very best grass grown for lawns and yards. A good sod of it with proper care will last for centuries. It will withstand, under favorable conditions, all the vicissitudes of the weather, the heat of summer, the cold of winter, parching droughts and sweeping floods.

It forms the greatest attraction of a country home. It is the groundwork of all natural and artificial decorations. Without this grass the shade is not half so grateful nor the flowers half so beautiful. For the embellishment of yards it is the best of all grasses. Wherever blue grass flourishes homes are more inviting and beautiful; lands are more valuable and in greater demand; the people are more intelligent and cultivated, have a nobler bearing and a higher sense of honor, become more highly educated; domestic animals are better bred and of higher types, both for beauty of form and for profitable marketing. In blue grass regions there is more wealth, greater taste, more real contentment, a larger hospitality, more ease and luxury, better society and fewer paupers, less worry, less enervating labor, more charming surroundings and happier families.

Blue grass is nature's sweetest smile; it is God's benediction; it helps to support us in life; it cheers us on our way by its freshness and beauty and it covers our last resting place with its perennial mantle of green, at once the emblem of life, of resurrection and of immortality.

ENGLISH BLUE GRASS OR CANADA BLUE GRASS.

(*Poa compressa.*)—(Grazing and Hay.)

English or Canada Blue Grass—Poa Compressa.

3. Panicle. 4. Upper leaf. 5. Spikelet. 6. Empty glumes. 7. Floral glume seen from the side.

In many of its features this grass resembles the Kentucky blue grass, but it has a more creeping habit, narrower panicles and flattened stems. The leaves have a deep bluish tint and it deserves the name of *blue* grass more than the blue grass does.

This grass does not require for its growth such fertile soils of calcareous origin as the *Poa pratensis* or blue grass. It is more hardy. It will thrive upon dry, sandy, thin soils. It flowers later than blue grass proper but its blades appear very early. Stock are very fond of it and it is rich in nutritive matter but the amount of its foliage is not great. Gould says: "Cows that feed upon it both in pasture and in hay, give more milk and keep in better condition than when fed on any other grass. Horses fed on this hay will do as well as when fed on timothy hay and oats combined. Sheep fatten astonishingly when fed upon it." This is high commendation but this commendation is more applicable to this grass when grown upon the soils and in the climate of New York than when grown in Tennessee. But little of it is ever seen in Tennessee, except among the mountains of East Tennessee. It is known in some sections as the "blue grass of the North." It is rarely sown in Tennessee. The price of the seed is quoted at $14 per 100 pounds or $2 per bushel. It is easily distinguished from blue grass by its compressed stems, its lower habit of growth, the want of fuzziness on its seed, its smaller panicles and by its intense bluish color. It deserves to be tried in Tennessee upon those soils where blue grass will not grow. Many farms in the more sandy regions of the state would probably increase their grazing capacity by the introduction of this grass, as it will withstand drought better than blue grass. It withstands cold as well. On good soils it will grow to the height of two feet and may be mowed for hay, of which it will make a yield of from one ton to one and a half tons per acre. The grass is said to lose less in drying than any other economic grass.

ROUGH MEADOW GRASS—(*Poa trivialis.*)—(Pastures.)

This grass is a perennial and is known in Lombardy as the queen of forage plants (La regina dell 'erbe.) It is closely related to blue grass but it has no conspicuous rootstocks and has rough stems and sheaths;

hence its name. It is said to be an excellent grass on good, moist, loamy soils, but it is not adapted to sandy or dry soils. It multiplies itself greatly by seed and does not throw out rhizomes and thicken by means of its roots. It forms a good bottom grass in pastures.

In England it is used for making hay as well as for grazing and is said to make more hay than rye grass. The hay is very sweet and nutritious and the partiality which horses, cattle and sheep show for it is a high recommendation. It will probably be a good grass for the mountains in the extreme eastern portion of Tennessee as it delights in a moist climate and sheltered situations.

This grass is best for a mixture and should be sown with Kentucky blue grass and orchard grass. It finds its most congenial situation in woodland pastures and on the banks of streams. In the climate of Tennessee it is totally unfit for hay-making, as the exposure of its roots to the sunshine destroys it at once. The seed weighs 15 pounds to the bushel and is free from fuzz. Half a bushel per acre is ample when sown with other grasses.

TEXAS BLUE GRASS—(*Poa arachnifera.*)—(Pastures.)

This grass, as its name would indicate, is a native of Texas, but it is now largely distributed throughout the Southern States. It is a hardy perennial and grows with great vigor. It has long leaves, creeping rootstocks and narrow but densely flowered panicles. It forms a thick turf and is well suited for making permanent pastures. It may be propagated by the roots or seed. The latter is so woolly that it is difficult to sow. The seed also sells very high, being quoted at $3 per pound or $42 per bushel. In rows two feet apart the roots may be planted one foot in the rows with a certainty of the early thickening of the grass by its creeping rootstocks. The roots may be depended upon much more surely than the seed for getting a stand.

Texas blue grass will grow faster and to greater height than Kentucky blue grass. It is one of the very best pasture grasses for the extreme south and it remains green throughout the year, even in as high a latitude as Tennessee. It grows during the winter months, and blooms the latter part of April or the first of May. It will stand more heat and will resist a drought better than blue grass, while its capacity for grazing is not surpassed by any other southern grass. Any good fertile soils and especially calcareous loams will grow this grass in rank luxuriance and beauty. It should take the place of Kentucky blue grass in all soils except those especially adapted to the growth of the latter, but Kentucky blue grass well set will endure longer than any other grass. The rich soils of East Tennessee appertaining to the small valleys are well adapted to the growth of Texas blue grass, as are the calcareous soils of the central basin and of the highland rim. The loess formation of West Tennessee supplies soils that will grow this grass to perfection. Having a southern habitat and being of southern origin, it will not endure severe freezes.

Texas Blue Grass—Poa arachnifera.

a. Spikelet. *b*. Flowering glume.

SWEET VERNAL GRASS—(*Anthoxanthum odoratum.*)—(Pastures.)

This is a perennial pasture grass and is only valuable because it is one of the first to shoot up its green leaves in the spring and one of the last to disappear in cold weather. It is almost worthless when sown alone but

Sweet Vernal Grass—Anthoxanthum odoratum.

it imparts to the pastures, or to hay cut from such pastures, an agreeable fragrance. It scarcely deserves notice, as its foliage when green is bitter to the taste.

The seed weighs 10 pounds to the bushel. A few pounds of seed as a mixture sown on an acre will not be objectionable in a pasture.

YELLOW OAT GRASS—(*Trisetum flavescens.*)—(Pastures.)

This grass has recently been introduced from Europe where it is greatly prized as a mixture for permanent pastures. It may be grown on every variety of soil but it seems to prefer in this country mountain slopes having fairly good soils. It is a slender, loosely tufted perennial with fibrous roots, and grows to the height of about two feet.

In England its natural habitats are dry pastures, heaths, rocky places and chalk meadows. Sheep and cattle relish the early foliage. The highest yield recorded in this country was when grown on clayey loam like much of the valley land of East Tennessee and of the highland rim.

Prof. Beal thinks it promises little for this country.

Prof. F. Lamson-Scribner thinks it has some agricultural value. But for the misleading name of oat grass it might be passed over without mention.

BERMUDA GRASS—(*Cynodon Dactylon.*)—Pasture and Meadow.)

Bermuda grass is of little or no value when grown above the 37th degree of north latitude. It is the child of the sun and luxuriates in a tropical or semi-tropical climate. It cannot stand the rigorous winters of

the northern states. The value of this grass has rarely been appreciated. Because it is a most troublesome weed in tillage it has been decried as almost worthless by a large class of planters in the south, who want corn and cotton and not grass and stock. Though regarded as a nuisance its merits are disclosed by the fact that when young and tender it is preferred by stock to almost any other grass and it is very nutritious. It is a friend in disguise. It is one of natures allies to conceal and heal the wounds inflicted upon mother earth by bad cultivation. It is the best of all natural agencies for stopping gullies. It will fasten its roots upon the bottom of the gullies and catch the burden of soil as it is carried down by a rain.

Bermuda Grass—Cynodon dactylon.

2. Inflorescence. 3. Spikelet. 4. Empty glumes.

As the bottom of gullies fill up the grass rises with it, building up, little by little, until the general surface is reached.

Bermuda grass is a perennial and the most valuable for a pasture grass of any grown in the cotton states. It will also grow on rich soils in all parts of Tennessee and especially in West Tennessee. Freezing weather endangers its vitality and therefore it will not do to rely upon in exposed situations, especially upon great elevations. It prefers sandy soils and fluviatile deposits, but it is not so well suited to sandstone soils such as obtain on the Cumberland table-land. It will readily grow upon the moist rich soils of the central basin but winter freezes often leave great vacant places upon such soils. The clayey soils of East Tennessee in proper situations will grow it in vigor. It has the capacity to endure the greatest amount of summer heat, and droughts that will threaten the vitality of all other grasses will not arrest its growth.

HOW IT IS PROPAGATED—Bermuda grass does not mature seed in Tennessee and only to a limited extent in the Southern States. The best and surest means of propagating this grass is to cut pieces of the turf and scatter it along shallow furrows or sow it over the land well prepared by plowing and harrowing and cover or compress the roots into

the soil with a roller or drag brush. A stand can be secured also by cuttings of the grass if it is at once distributed over the land and covered.

A writer in the Southern Farm Magazine says: "Let the plants be gathered, root and branch, from some patch of ground thickly occupied by them. Let them be shaken free from earth and passed through the cutting-box as though designed for the manger of an animal. Let these giblets of an inch long be sown by hand broadcast before the harrow along with the oats in the spring of the year. Every joint will be as sure to germinate as the seed corn. But the little plants will be too tiny the first year to interfere at all with the cereal crop. The next year the old stubble will have become the Bermuda sod, yielding an almost incredible amount of pasturage and incapable of being grazed out by the severest treatment in the hottest summer drought."

Seed is rarely sown for two reasons. One is that the seed is expensive and sells for $1.00 to $1.25 per pound, and a still better reason is that the germinating power of the seed obtained from the West Indies is very low.

When Bermuda grass is once thoroughly rooted it spreads itself with amazing rapidity and soon takes possession of a field. It is extremely difficult to exterminate. It should never be planted on any land intended for tillage as it becomes a very troublesome pest. Shade will ultimately destroy it. A crop of peas sown upon the land for two or three years will do much to exterminate it. Exposure of the roots to winter freezes, which is done by shallow plowing, often destroys it in the latitude of Tennessee.

Rev. C. W. Howard, a well known writer on grasses, says he has found "no difficulty in destroying it upon the uplands of Georgia by close cultivation in cotton for two years. When not pastured broom grass or briers soon destroy it." He also thinks it very doubtful whether "there is one acre of land in the South thoroughly set with Bermuda grass that is not worth more than any other crop that can be grown on it."

Dr. C. W. Dabney says: "The Bermuda grass sod, not only in the cotton states, but in Virginia, has proved itself the most fruitful of all pasturage. There are well-known fields, not on superior soil and never fertilized, which are today fattening more than one head of cattle per acre. This will almost equal the blue grass in Kentucky. Some wheat farmers in Virginia have almost surrendered tillage for the sake of cattle rearing upon these Bermuda grass fields, because they have found live stock more profitable than wheat, and their present pursuit free from many vexations. The farmers upon the red-wheat lands of Virginia report that Bermuda grass can be entirely dispossessed by turning it under and keeping it constantly under the plow for two or three years. In this case they advise, after taking off the wheat crop in June, to plow the stubble under and sow the field in peas. In September the peas are turned under as a fallow crop and the field resown in wheat. After two or three summers of this double cropping, which should yield profitable returns in itself, Bermuda grass will be found to be extirpated by the shade of the pea vines while the enrichment of the soil still continues."

For the making of hay Bermuda is held in high esteem in all those

Bouquet of Grasses From the Grass Garden, Tennessee Experiment Station.

(U. S. Dept. Agric.)

sections of the South where it grows to a sufficient height for mowing. The grass must be cut early and often to make good hay. If left until the culms harden it is almost valueless for feeding purposes. Just as soon as it grows high enough it should be cut and cured much after the manner of timothy hay. Prof. S. M. Tracy, in an address delivered before an Agricultural and Horticultural Convention in Jackson, says of its hay-making qualities:

"With us, Bermuda is the staple sort for both hay and pasture. It grows well all through the South, will make from two to four tons of hay per acre and the hay is fine, tender and nutritious. During the summer it gives the best of pasture, and is uninjured by the longest droughts. At the Experiment Station we have been feeding with both Bermuda and timothy hays during the last three years, as a test of their feeding values. The timothy was selected especially for the purpose by a man who ships that hay very largely and was of the very best quality; the Bermuda was purchased from a neighboring farmer. Without going into the details of the trial, I may state that, ton for ton, we found very little difference between the two, though the balance was slightly in favor of the Bermuda. As the timothy cost, delivered at the Station, nearly twice as much as did the Bermuda, the balance of profit was very decidedly in favor of the home-grown hay."

Prof. Phares, writing in the early seventies says of it: "As a perennial pasture grass I know of no other that I consider so valuable as this. As hay this grass has been cured and held in high esteem in Mississippi for more than forty years. It does not bear dense shade but grows best where most exposed to the intense heat of the sun. To make good pasture it must be kept well trodden and grazed to keep it tender, and to suppress other objectionable grasses and weeds. To make good hay and the largest yield, this grass must be mowed from three to five times every summer. Thus briars, brome grass and other weeds are also repressed and prevented from seeding, multiplying and ruining the meadow. Properly managed this grass grows from ten to fifteen inches high."

BERMUDA GRASS AND SHEEP—Bermuda grass has long been recognized as one of the very best grazing grasses for cattle in the United States, but its capacity for carrying large flocks of sheep has not received the attention from the people of the South which the subject merits. No grass will bear tramping so well in all kinds of weather. The Southern States are the largest producers of cotton in the world; they should rival or surpass Australia in the production of wool. On the same plantations where cotton grows best, Bermuda grass finds its most congenial home. The cheapest wool should be produced on the same fields that produce the cheapest cotton. One acre of Bermuda grass well established on soils entirely adapted to its growth will carry ten sheep for eight months in the year, and in many parts of the South, ten months. Texas blue grass, sheep fescue, and in some places Kentucky blue grass, when properly cared for, will carry the flocks through the remaining months. When one considers the great profits that may be derived from the sale of early lambs in the northern markets, and the growing demand for first-class American wool and mutton, it is not too much to expect that within the

Botanical Description of Wheat—Triticum sativum.

On the left, a "head" or spike of beardless wheat. *A*, a single spikelet; the two uppermost florets are reduced to small sterile or empty glumes. *C*, empty glume seen from the side. *Cx*, the same seen from the back. *D*, flowering glume. *E*, palet. *K1*, grain seen in front. *K2*, the same seen from the back. *R*, a portion of the axis of the spike. *J*, the pistil. *G*, lodicules. On right, a "head" or spike of bearded wheat.

Wheat, which belongs to the same family as the grasses here described, is occasionally cut in the spring or early summer for forage. It is frequently grazed a little, but must not be too much grazed.

next score of years sheep and wool, mutton and early lambs will be as well known products of southern agriculture as cotton is at the present time. The establishment of Bermuda grass pastures for the purpose of carrying sheep, supplemented by pastures of winter grasses, will work an industrial revolution in the South. This would bring about a realization of untold wealth. It is a prize well worth contending for to be the largest producers in the world of two of the most important fibres for clothing the population of the globe. They form the basis of the most numerous and most useful industrial establishments in the world, which give employment to a larger number of people than any other manufactories. A larger part of this cotton and wool should be manufactured where produced.

SMOOTH BROME GRASS—(*Bromus inermis.*)—(Hay and Pasturage.)

Smooth Brome Grass—Bromus inermis.
2. Panicle. 3. Upper leaf. 4. Spikelet. 5. Empty glumes. 6, 7. Floral glume.

About 1880, the Agricultural Experiment Station of California introduced this perennial grass into that state from Europe. It is stolziniferous like Bermuda grass and soon makes a thick turf. It seems to be adapted to every climate from Canada to Tennessee, and was grown successfully at the Experiment Station at Knoxville. It resists droughts and cold equally well and thrives upon dry, loose soils and so may be well adapted to the Cumberland mountain region. It grows, however, more vigorously upon good soils. It is difficult to exterminate, but not so much so as Bermuda or Johnson grass. It possibly may supply a want on the gravelly soils of East Tennessee and of the siliceous soils of the highland rim. Its introduction, however, is attended with some risk. It remains green the greater part of the winter and is desirable as a winter pasture. It is said to be low in its nutritive elements. A bushel of seed weighs 14 pounds and sells for $20 to $22 per hundred pounds. As three bushels of seed are required for one acre, it is hardly probable that the grass will receive much attention from the farmers of Tennessee. It is one of those grasses of questionable value that may prove an enemy rather than a friend to the farmer. If in its habits it at all resembles its kindred grass, cheat, (*Bromus secalinus*) its introduction would be altogether injurious to the best interests of agriculture.

Botanical Description of Oats—Avena sativa.

A, a portion of the inflorescence which is a simple, open panicle. *B*, a spikelet, two-flowered, with a sterile rudiment terminating the rachilla. *C*, one of the broad, lanceolate empty glumes. *D*, a flowering glume; this bears an awn on the back just below the two-toothed apex. *J*, pistil; the ovary of which is very hairy. *G*, lodicules.

The oat is a most useful forage plant; but its culture and uses are well understood and require no discussion here.

RESCUE GRASS—AUSTRALIAN OATS—(*Bromus unioloides.*)—(Winter Grazing.)

This grass is a native of South America. It is an annual, but as it seeds freely the young plants succeed the old ones so quickly that it is practically a perennial. It supplies good grazing during the winter. It grows from one to three feet in height. It makes its best growth during cold weather and has come to be regarded as an excellent grazing grass for the winter months. It resembles chess or cheat in its habits of growth, and danger to agriculture may lurk in its introduction. It is

Rescue Grass—Bromus unioloides.
2. Panicle. 3. Upper leaf. 4. Spikelet. 5. Empty glumes. 6. Flowering glume.

not therefore recommended for cultivation to the farmers of Tennessee. The notice of this and the preceding grass is made as a warning rather than as a recommendation. Farmers will never regret the exercise of due caution in the introduction of new and but partially known grasses. They have herd's grass and blue grass and wheat, rye, barley and winter oats that will serve as winter pastures without taking the risk of introducing a strange grass with unknown qualities that may prove to be an enemy.

HAIRY FLOWERED PASPALUM—(*Paspalum ovatum or dilatatum.*—(Pastures.)

This is a perennial, said to be a native of Brazil, and is considered an excellent grass for late pastures, as it makes its principal growth in autumn. Dr. Gattinger, of Nashville, mentions it in his Tennessee Flora as being one of the grasses found in open ground and in grass plots. It

grows from two to four feet high and has long narrow leaves. It is greatly relished by stock and does not appear to have any troublesome qualities.

There are twelve species of this grass, according to Dr. Gattinger, found in the Southern States, seven of which are found in the State of Tennessee. He says: "The various species which represent this grass within the State of Tennessee rank, in my opinion, foremost by the number of individuals, nutritious qualities and tenacity of life, amongst the whole of the grazing herbage. They are perennials with thick, strong,

Hairy-Flowered Paspalum—Paspalum ovatum.

2. Inflorescence. 3. Upper leaf. 4. Spikelet. 5. Spikelet laid open. 6. Floral glume. 7. Palea and lodicule.

running roots, often making a dense matting. Wherever they take hold other plants disappear. * * * Blue grass and paspalum are frequently commingled but the latter succeeds the former by four or five weeks and comes in full force after the former has perished away. They are vigorous growing succulent grasses with heavy culms, large and smooth seed grains with a smooth and thin epidermis. They must surely be very nutritious and their habit and cultivation ought to be studied."

PART II.

DOMESTICATED LEGUMINOUS PLANTS.

The leguminous plants embrace not less than 6500 species. They are widely distributed in every quarter of the globe and vary in size from a lowly plant that scarcely lifts its head above the surface to the majestic locust trees found in tropical lands.

Of the leguminous plants Dr. Gattinger in his Tennessee Flora enumerates 35 genera, 85 species and 3 varieties, making 88 species and varieties. Nine of these have been introduced, three are woody plants, three are trees and seventy-two belong to the flora found in the counties immediately around Nashville.

For the making of hay and for pasturage many of these leguminous plants rank with the best domesticated grasses in nutritive elements, and in their capacity for furnishing forage for live stock. As a restorer of worn-out soils leguminous plants are far more valuable than the grasses. Every leguminous plant is endowed with nodules, the habitat of special microbes, which have the power of catching free nitrogen from the atmosphere, this nitrogen being assimilated by the plant itself. These microbes are believed to embrace as many species as there are species of leguminous plants, and the cultivation of one leguminous plant is thought to destroy the microbes of another. "Clover sick" is probably due to the destruction of the clover microbes, or bacteria. To preserve the fertility of the soil it is important that leguminous plants become one of the crops in rotation, and there should also be a rotation in the leguminous crops themselves. Clover should alternate with cowpeas, soy beans, crimson clover, etc. Nitrogen, in leguminous plants, occurs in the form of proteids, which make meat and milk, and so is the most valuable constituent in the food for cattle, especially for milch cows. The dry forage of leguminous plants is worth nearly twice as much for such stock as dry hay.

The following domesticated leguminous plants will be discussed in the order named in this bulletin:

Red Clover—*Trifolium pratense.*
Crimson Clover—*Trifolium incarnatum.*
Bur Clover—*Medicago maculata.*
Alsike Clover—*Trifolium hybridum.*
White Clover—*Trifolium repans.*
Sainfoin or Esparcet—*Onobrychis sativa.*
Melilotus—*Melilotus alba.*
Lucern, or Alfalfa—*Medicago sativa.*
Cowpeas—*Vigna catjang.*
Peanuts—*Arachis hypogæa.*
Japan Clover—*Lespedeza striata.*
Soy Bean—*Glycine soja* or *Soja hispida.*

Short mention of other domesticated leguminous plants will also be made.

RED CLOVER—(*Trifolium pratense.*)—(Pasture and Hay.)

There is no forage plant in all respects so useful to the American farmer as red clover. It has been well styled the corner stone of agriculture and this because it seems to be the concomitant or forerunner of all successful agriculture. In the border States a farmer who is too poor to sow clover is too poor to own a farm. In our climate and soils this plant is well nigh indispensable. The soils of Tennessee fatten upon it. It furnishes an immense amount of grazing, yields an abundance of nutritious hay, and is a profitable crop, considered with reference to the seed alone. But beyond all these it acts as a vigorous ameliorator of the soil, increases more than any other forage plant probably the amount

CLOVER FIELD AT SOMERVILLE, TENN.

of available nitrogen, supplies humus and so becomes an important agent in keeping up the productive capacity of the soil, increasing the yield of other crops and thus adding to the prosperity of the farmer who sows it. Scientific inquiry has about reached the conclusion that the little excrescences or tubercles upon the roots of clover enable the plant to utilize the free nitrogen of the atmosphere as an important element of fertility. It must be borne in mind that a soil may contain the most abundant supplies of every substance demanded by a growing plant, and yet that plant may perish of starvation. If these substances are not in a condition to

be dissolved by rain-water or the plant juices they are as impotent to support plant life as the uncrumbled surface of a desert rock. The food must be prepared for plants just as the corn and wheat must be shucked or threshed, ground and baked for the use of man. Clover acts as the miller and baker for other crops. It prepares the food so that it becomes available and digestible by them.

SOILS ADAPTED TO ITS GROWTH—Red clover is a biennial plant, which under judicious tillage, may be made practically a perennial, and is specially adapted to calcareous or limy soils; but it will grow well upon sandy soils, when a "catch" is secured, by the application of a top-dressing of gypsum or barnyard manure. I have seen it growing with vigor upon the feldspathic soils of Johnson county, upon the sandstone soils of the Cumberland table-land, and upon the sandy loams of West Tennessee; but it finds a more congenial soil in the clayey and limy lands of the valley of East Tennessee, or on the red soils of the Highland Rim, and grows most luxuriantly on the limestone loams of the Central Basin. But the deep, black, porous soils of this division are not suited physically for the growing of clover. Such soils become very dry in summer and open in great cracks or fissures. The clover grows well enough at first but is apt to be killed by the dry, hot weather of summer. The clayey lands of West Tennessee, containing nodules of calcareous matter, have no superior for the production of clover. It often grows upon these lands from four to five feet in height, and when it falls forms a mat of great density and thickness. As much as four tons of clover hay have been taken from a single acre. There is also a soil derived from the Dyestone or Clinton formation in East Tennessee that grows clover with surprising luxuriance. On such soils in McMinn county, the ordinary red clover sometimes grows six feet in height. Probably three-fourths of the lands in Tennessee will grow clover remuneratively, and of the soils that will not a large portion are included in the old gullied fields that constitute the shame and mark the shiftlessness of too many farmers. It may be set down as an infallible rule in the State of Tennessee that good farming and abundant clovering go together.

SOWING CLOVER—Clover may be sown in Tennessee upon wheat, rye or oat fields, or alone. Instances have been reported where a splendid stand was obtained by sowing after cultivators in the last working of corn in July. This is unusual however. So is fall sowing. The best time to sow is from the first of January until the first of April. If sown in January or February, the seed ought to be sown upon snow. This is not only convenient in enabling one to distribute the seed evenly over the land, but the gradual melting of the snow, and the slight freezes, bury the seed just deep enough to insure rapid germination when the warm days of March come on. For the same reason, if sown in March, the seed ought to be sown when the ground is slightly crusted by a freeze. If the sowing is deferred until too late for frosty nights, the land should be well harrowed and the seed sown immediately after the harrow. Upon land seeded to wheat, this harrowing will not only serve to secure a good stand of clover, but will add greatly to the yield of the wheat. It will hasten germination and cause a larger proportion of seed

to grow to harrow the land after the seed is sown. With oats, the seeds should be sown after the last harrowing or brushing, with a slight after-brushing to cover them.

It often happens when clover seed is sown with wheat or oats, especially if the land be much worn, that a "catch" will not be obtained. The practice is so universal throughout the country of sowing clover with small grain, that many farmers labor under the impression that this is the only way of seeding land to clover. This idea is erroneous. A better stand of clover with less seed, may always be secured by sowing upon land prepared for clover alone. An excellent catch upon "galled" places may be had by breaking the land well and sowing the seed without any previous or after harrowing. In nine cases out of ten a stand will be secured in this way upon soils where clover sown with small grain will fail in nine cases out of ten. Clover seed sown upon a well harrowed stalk field will, in most cases, secure a stand.

The quantity of seed to sow per acre depends upon the character of the soil, its state of pulverization and also upon the fact whether the land has ever been seeded to clover. Upon good, fresh, rich soils where clover has not been previously grown, one bushel for eight acres should be sown. If the soil is thin and unproductive one bushel for six acres ought to be sown. If the land has been regularly rotated with clover, one half the quantity of seed mentioned above will suffice; sometimes much less. Clover seed, owing to the large quantity of oil which it contains, is nearly indestructible when placed ten or twelve inches beneath the surface.

The frequent failure to secure a good stand of clover should admonish the farmers to exercise more care in the seeding. When sown late in the spring many of the seeds sprout and are killed by dry weather. It would be all the better if the clover seed could be buried a half inch (or even an inch on loose soils) beneath the surface after the middle of March. The common practice in England is to sow not only clover, but all grass seeds, with oats or barley in spring. After the seeds are sown the field is harrowed and then rolled, so as to cover them and at the same time to smooth the surface of the field. While upon well prepared soils a bushel to eight acres is sufficient, yet a bushel to six acres will, in a majority of cases, give better and more satisfactory results. In England 24 pounds are usually sown to the acre when the crop is intended for hay. The smaller the stem the more acceptable it is to cattle. When the clover is thin, the woody fibre is greatly increased. There is no greater blunder committed by the farmer, than to be sparing of grass seed. It is difficult for grass to be too thick. The plants shelter one another; they retain for a longer time the dew and moisture when thickly set, and they must push upward as there is no lateral space to occupy.

GROWTH AND MANURE—Red clover rarely makes much growth the first season, if sown with grain. Should the weather be seasonable after harvest, and the land fertile, it will sometimes attain the height of thirty inches and put out blooms, making an excellent fall pasture. When sown alone, it will always blossom in August.

Sheep and hogs are very injurious to young clover, and should never

be allowed to run on it until the second year. Grasshoppers often eat out the crown and destroy it. Dry weather in a stubble field where the rays of the sun are reflected and repeated a thousand times from the surface of the yellow stubble, is very trying to its vitality. Yet if the land has been well and deeply broken and is moderately fertile, a sufficient stand may be depended upon.

As soon as the clover begins to grow, in early spring, an application of two bushels of gypsum or land plaster, upon granitic or sandy soils, is absolutely necessary to get a good growth.

An application of gypsum is rarely beneficial upon clayey loams, but its effects are very apparent on strong limestone soils, such as are found in the Central Basin. where from 50 to 100 pounds per acre should be sown upon clover. On the chocolate colored soils of Warren, Montgomery, Stewart and Robertson counties, gypsum benefits clover very little. Upon the soils of the Unaka and Cumberland mountains, it is indispensable, to secure a remunerative yield of foliage.

Mr. C. W. Johnston in a prize essay on the application of gypsum to the artificial grasses, says that it should not be considered as a stimulant, but as an essential food. "When the farmer finds that those fields which once produced luxuriant crops of red clover, or sainfoin, will no longer yield them in abundance; if he notices that the young plants spring up very numerously, but die away as the summer advances; if he finds that his fields will only grow clover successfully once in eight or twelve years, and that his neighbors tell him his land is tired of clover, or "clover sick," he may then safely conclude that his crops have gradually exhausted his land of sulphate of lime; and he may, with every confidence of success, apply a dressing of gypsum by scattering it evenly over the ground on the clover plants at the rate of 200 pounds per acre, taking care to choose a wet morning for the application; and this may be done at any season of the year, but it is best either in April or the first days of May." In Tennessee gypsum should be sown in the spring as soon as the clover begins to grow, and again the following spring.

Mr. Smith, of Highstead, England, states that he found the greatest benefit from the use of gypsum to his clover leys; for where the simple soil produced one ton only per acre of hay, the portion of the same soil to which five bushels per acre of gypsum had been applied, yielded three tons—the first only yielding 20 pounds of seed while the latter produced 105 pounds. Mr. Smith, too, first noticed what observation has since confirmed—that cattle, horses, etc., always prefer the clover growing on the portion of the field that had received an application of gypsum to any other. The same remark is made by those who spread coal ashes, which contain a considerable quantity of this earth, on their grass leys.

Red clover, the second year, has two growing seasons. It makes its most vigorous growth from the first of April until the 15th of June, beginning to bloom usually in the latitude of Tennessee about the 15th of May, and attaining its full inflorescence about the first of June. After this, unless pastured by stock or cut for hay, the heads begin to dry up, and stems and leaves begin to fall, forming a mat upon the land. Sometimes this mat is so thick as to catch and concentrate the heat of the sun

to such a degree as to scald the roots and destroy the clover. Usually it is best after clover has attained its full bloom, either to cut it for hay or pasture it until about the first of July, when the stock is removed, or the clover hay cured and taken off. If there is rain enough, a second crop will spring up from the roots at once. This second crop is the most valuable for seed, the seed maturing about the last of August and sooner, if there be copious rains. To make the most abundant yield of clover for grazing, it should be allowed to grow all it will, but never let it make seed, always grazing it down when in full bloom. When grazed down, take off the stock until it blooms again. Several successive crops may thus be made during the summer. The crop of August is unfit for horses or mules, the seed having the effect of salivating them to such a degree as to cause them to lose flesh.

Clover has no superior as a grazing plant. When in full vigor and bloom it will carry more cattle and sheep per acre than blue grass, herd's grass or orchard grass. After it has been grazed to the earth, a few showery days with warm suns will cause it to spring up into renewed vitality, ready again to furnish its succulent herbage to domestic animals. Though very nutritious and highly relished by cattle, it often produces a dangerous swelling called hoven, from which many cows die. When first turned upon clover, cattle should only be allowed to graze for an hour or two, and then be driven off for the remainder of the day, gradually increasing the time of grazing, until they become less voracious in their appetites, never permitting them to run upon clover when wet. Clover made wet by a rain at midday is more likely to produce hoven than when wet by dew. If taken in the stomach of cattle when wet by rain at midday, and after the stalks and leaves are heated by the sun, fermentation in the stomach will occur much sooner than when the herbage is cool, though wet with the morning dew. Cattle are more easily affected by clover than horses, because, being ruminants, they take in the clover rapidly, filling the stomach at once, without chewing. Digestion is for the time checked and a rapid fermentation sets in.

Stock should never be turned upon clover until it blooms. The practice of many farmers, to turn all the stock upon a clover field early in April, is very destructive. The crown of the clover is eaten out, causing it to perish. The tread of heavy cattle has the same effect.

As a soiling crop red clover is excelled by no crop grown in the South. The practice of soiling in thickly settled communities is one much commended by agricultural writers. A half-acre of clover on a rich soil will supply one cow throughout the months of June, July and August, if cut off and fed in a stall, while twice the amount in pasture, according to some English experimenters, will barely subsist a cow during the same period; but this will depend, of course, upon the luxuriance of the growth. Soiling—that is cutting the grass and feeding it green—is a very desirable practice, near small towns, where many persons own small lots and desire to keep a milch cow. No other plant, perhaps, will produce a larger flow of milk.

EFFECTS OF CLOVER UPON SOILS—Numerous facts have taught the farmers of every country where agriculture has flourished, that

in many cases the value of the aftercrop depends upon the preceding crop. In other words a proper rotation is a necessary antecedent to successful farming. The cultivation of some crop with extensive root ramifications, will prepare the soil for the subsequent growth of a cereal. But the farmer should not deceive himself. Every crop takes away a part of the available plant-food and the field has not increased in fertility, but the plant-food has been made more readily effective for the production of a crop. "The physical and chemical condition of the fields has been improved, but the chemical store has been reduced." "All plants," says Liebig, "without exception, exhaust the soil, each of them in its own way, of the conditions for their reproduction."

A field then, which produces more kindly after rotation, is not necessarily more fertile, but is in better physical condition. It has already been mentioned, that the mechanical effects of clover upon soils is not the least among its valuable properties. The reaction rendered possible by the penetration into the soil of the long tap roots and the effect of the dense shade upon the land have a tendency to increase the productiveness of the soil.

Clover, however, is the greatest of all fertilizing plants. Other leguminous plants as well as clover collect nitrogen from the atmosphere and save it, but clover more rapidly improves the physical condition of the soil. A crop of clover taken from the land, while it abstracts some of the elements needed for plant growth, yet, in increasing the content of nitrogen, it gives back to the soil much more of value than it takes away. Clover has been called "a trap for nitrogen," which it catches and preserves for the nourishing of growing crops. Dr. Kedzie says: "Clover hay or sod contains enough phosphoric acid for more than double an average crop, enough nitrogen for more than four average crops and enough potash for six average crops of wheat."

The analysis of red clover indicates what manures would increase its growth. Sulphate of lime or land plaster, the phosphates, wood and coal ashes, are all excellent top dressings for the clover field. Common stable manure, containing as it does all the elements of a good fertilizer, is suitable as a top dressing for any pasture or meadow.

Sulphate of lime is found on limy or sandy soils, to largely increase the growth of clover. When used on a wheat field seeded to clover in early spring, a "catch" of clover will be secured on the thinnest spots and it will grow luxuriantly after such top dressing. The greatest benefits from an application of commercial fertilizers upon wheat are often obtained in this way. A good stand of clover, however secured, is the best possible preparation of land for a succeeding crop of wheat. And this arises not only from the available nitrogen which a clover crop supplies, but from the thorough subsoiling which is effected by the deep, penetrating tap-roots of the clover. They often descend to the depth of four feet in search of food, while its broad leaves "absorb carbon from the atmosphere, changing it into solid matter, and causing elements in the soil to assume organic forms, rendering them more available as food for other crops." If the soil be robbed of its fertility, the deficient elements must be added before clover will "take."

As clover derives a large percentage of the constituents necessary to its growth from the atmosphere, it is all important that there should be a good top growth. Its value as a renovator of the soil depends largely upon the quantity of the roots, and the roots will always be proportioned to the quantity of foliage. For this reason it is better to cut clover off than to feed it off. A writer in the American Cultivator, speaking of this subject, says:

"Where a clover sod is desired for future grain or other crop, it will be found that the cutting of clover is generally better than feeding it off, because every leaflet upward has rooted downwards, and if a leaflet be taken off the rootlet will not grow, so that if sheep or pigs be fed upon the surface, the constant cropping of the leaves diminishes the under production. Always feeding the top will leave but few roots below. This was illustrated by a practical experiment on a field of clover, divided into two parts. The whole was cut in July; half was left to grow again, and the other half fed off. In October the roots of each division were dug up, carefully cleaned and weighed, with a result that showed a proportionate weight of 3,920 pounds to the acre where the clover was cut once and fed afterwards, while the part on which the clover was cut twice yielded at a rate per acre of nearly 8,000 pounds of roots. The system of cutting instead of feeding resulted in leaving two tons extra of vegetable matter, valuable in nitrogen, and which had a perceptible effect on the corn crop that followed."

WHEN TO CUT AND HOW TO CURE CLOVER HAY—Clover for hay should be mowed at the time when the nutritive elements —those elements which give strength and produce flesh—are at their maximum. Those who are in the habit of feeding stock find that clover cut about the time of full bloom, when a few of the blooms begin to dry up, and just as the reproductive functions are being brought into play for the maturing of seed, will, pound for pound, produce more fat and muscle than that cut at any other stage. The only art in curing hay is to retain as many of the life-giving constituents in it as possible, or to preserve it as nearly as practicable in the same condition in which it is cut, with the water only abstracted.

The plan generally adopted is to mow the clover in the morning and let it lie in the sun several hours until a wisp taken up and twisted will show no exudation of moisture. It is then thrown up into small cocks, say four feet in diameter and four feet high. In these, unless there is appearance of rain, it is allowed to remain for a day or two, when it may be hauled to the barn and stored away without danger of damage. Care should be taken not to let the dew fall upon it as it lies scattered by the mower after it has begun to cure. The dew of one single night, under such conditions, will blacken the leaves and destroy the aroma for which good clover hay is so much prized.

Another plan practised is to mow it and let it lie just long enough in the sun to wilt, and then carry it to an open house and lay it upon beams or tier-poles, where it can receive the free action of the air. After a few days it may be packed down without any danger of fermenting. Cured in this way, in the shade, it retains its green color, is fragrant, and

makes a most excellent feed. The only objections to this plan are the great amount of room under cover required for curing, and the additional burden of hauling while green.

Another plan is to haul it up as soon as it wilts, using about half a bushel of salt to the ton of cured hay. A layer a foot or more in thickness is put down, over which salt is scattered pretty freely, then another layer and salt, continuing to repeat the operation until the space set apart for hay is filled. A rapid fermentation will ensue, and the hay will be cured by the heat of this fermentation, the salt acting as a preventive against putrefaction. Instead of salt, layers of wheat straw may be substituted. By using straw the clover may be cured in the field. The quantity of straw to be used in the rick or stack depends upon the moisture in the clover—the greener the clover the thicker should be the straw. The straw will act as an absorbent and during the process will itself be greatly increased in value as food for stock, having imparted to it the flavor and aroma of the clover plant.

One of the largest farmers in Maury county, Tennessee, whose land is admirably adapted to the growth of clover, and who has made a great success in saving clover hay, gives the following account of his method of saving it:

"Clover should be cut when about half of the first blooms are dead, to make the best hay. My plan is to begin cutting early in the morning and continue throughout the entire day. The next morning just before the hay becomes entirely free from the dew I rake it into windrows, then put it into shocks where it remains from 24 to 36 hours. I never permit it to remain spread out on the ground until it becomes dry and crisp from the heat of the sun. Putting it up into shocks while yet green or half cured causes fermentation to begin immediately, but this fermentation is not excessive because the air can penetrate it and keep it comparatively cool. I rehandle it after it has begun to heat, which airs it well and it then remains perfectly bright and sweet after it is put into ricks or barns. No other rehandling is necessary except that which is incident to the hauling and storing of it. In threatening weather I put up my hay in the barn after one day's sun, but in that case I rehandle it after 36 hours and it is thus aired thoroughly. My opinion is that fermentation, if left undisturbed, will injure the hay for food because it usually induces mould and in this condition it is objectionable to stock. I never stop cutting hay for rain, though a protracted rain will ruin it. One rain only will make it of dull color, but does not materially change its value as food for stock.

"There is no hay known, in my opinion, to southern farmers that equals good clover hay for stock. I prefer it to choice timothy for regular feeding. It is the principal hay, which I use for horses, mules and cows and they never seem to tire eating it and always keep healthy and fat. In the management of my clover fields I usually sow about 50 pounds of gypsum per acre upon young clover and repeat early in March the following year. This gives a very large yield of hay. My clover crop is probably as profitable as any crop I grow. I estimate its value one year with another at $20 to $25 per acre."

Hon. L. N. Bonham, of Oxford, Ohio, uses a different method in putting up clover hay. He says:

"For several years I put up clover hay as did my father and other Jersey farmers. I have long since abandoned their method and now put my clover hay in the mow the same day it is cut. The hay is far better, and the labor and risk in making it are far less. I select a bright day and start the mower as soon as the dew is off. By 11 o'clock I have cut as much as can be hauled in between 1 and 5 o'clock. The clover is then all turned and shaken up loose before we go to dinner. By one o'clock it is dry enough to rake into windrows if the day is an average hay day. No time is lost now in getting it into the mow. The hay is warm and free from external moisture. The warmer it is the less moisture is left on it. By five o'clock we have it all in the mow, if we can. If not all in then, we prefer to leave it in the windrow until near noon the next day. After we stop hauling, at 5 p. m., the mower is started to cut what we can haul in the next day. The clover cut so late in the day is not wet with dew, and will not wilt enough to be blackened by the dew. It will be ready to shake up and spread out before ten o'clock the next day, and by one o'clock we can begin to haul it into the mow.

"The clover hay thus made goes into the mow bright and with every leaf and head left on it. The secret of the whole business is, it is free from external moisture, while the warmth of the hay when it goes into the mow hastens the approach of the temperature of the mass up to 122 degrees when the germs which cause increased fermentation are destroyed, and the hay keeps bright and sweet, and comes out fragrant clover, with all the heads and leaves of good color. My mow is 28 by 28, and as tight as good siding and strips painted can make it. There are no windows in the sides to let in air. The clover is put in as compactly as we can get it, to save room, and kept level, to have the heat uniform. Sometimes we sprinkle a half gallon of salt to the load when putting into the mow, but this is of doubtful value.

"To exclude the air from the top of my clover mow, I often cover with straw. But this does not pack closely. I find it better when hauling in wheat to fill up over the clover with wheat. This excludes air, and packs the clover so that it keeps bright to the very top. The old theory that the mow must be open and the clover thrown in loose, and treated to 'plenty of salt,' which may mean much or little, is exploded. Green clover will keep green in the silo if well packed and the air is excluded. Clover hay, put into the mow warm and dry, the day it is cut, will keep brighter and purer and sweeter than if cured longer in the field.

"The trouble, however, in farmers adopting the method I have successfully used, is they do not attach enough importance to the fact that the conditions named must be followed. It will not do to cut clover in the morning and haul it in after sun-down. It will surely mould or come out brown or fire fanged, simply because dew falls at five o'clock. Nor can we cut clover and put in the mow the same day without favora-

ble conditions of sun and air. In neither case will the hay go in free from external moisture."

It should always be borne in mind that clover hay will not shed rain. The best farmers now build open sheds in the field for storing it. When stacked it should either be thatched or have a thick top-covering of wheat straw or other hay. The tedder is thought by many to be indispensable in saving good clover hay. Unquestionably it is of great service, and the hay made by the use of the tedder in dry, hot weather, is superior to that made without, but good hay can be and is made by many farmers who never saw a tedder. Clover hay is more difficult to cure than hay from any of the true grasses, and this arises from the fact that it contains more water than the true grasses. For this reason also, it is more difficult to keep, being more liable to damage in the mow. It will not bear handling or transportation except when damp and while it will always be a favorite hay for home consumption, it will never be shipped to distant markets like timothy hay. For horses and mules clover hay is very nutritious. Many persons make a crop by feeding on clover hay without any grain whatever and the working stock keep fat. Clover is also a superior hay for cattle, producing in milch cows a fine flow of milk. It makes the best hay when the stalks are small and stand thickly upon the ground.

SAVING CLOVER SEED—All the clover seed used in the border states should be produced in them. Besides, there should be a large surplus to be sent to other markets, for no section of the Union will produce, acre for acre, a larger quantity. Six bushels per acre have sometimes been gathered, although the usual average is about three bushels. Large quantities are grown in and shipped from Bedford, Maury, Williamson and other counties in Tennessee.

As the first crop of clover, coming to maturity in June, will not perfect its seed, this must be removed either by feeding or by mowing for hay. The seed must be gathered from the second crop. The quantity of seed will depend much upon the weather. Should there be much rain or heavy winds, the yield will be small, but when the weather has been fine and calm and the seed free from dock or other noxious seeds, the crop will be as remunerative as any other grown by the farmer. A bushel of clover seed will weigh usually about 64 pounds, though 60 pounds is the standard bushel by the statute regulation.

The second crop of clover should be allowed to stand until the husks have become quite brown and the seeds have passed the milky state. It should then be mowed and permitted to lie upon the ground until it is well cured. After it is cured rake it up into swaths. Rain will rather benefit than injure it, making it easier to separate the heads from the haulm, which is done by passing through an ordinary wheat separator. A clover huller attachment is adjusted to the separator below the vibrator, which hulls the seeds, and they are separated from the chaff by the fan, care being taken to shut off as much air as possible by closing the sliding doors. Machines are now made especially for threshing clover seed.

The crop of seed can be largely increased by mowing or feeding off the first crop of clover about the first of June, and then top-dressing with

stable manure. The earlier the first crop is cut the larger will be the crop of seed. By treating the clover fields in this way, the yield of seed is often doubled. Uplands will yield more seed than bottom lands, but they should be enriched by a liberal application of manure. About the first of September is the time to mow for seed, and the straw will thresh all the better for being exposed to the weather for three weeks. The threshing is usually done in the field, though the haulm may be hauled up after being thoroughly dry, and stacked with a good straw covering, or else stored away under shelter on a good tight floor until it suits the convenience of the farmer to thresh. Care should be taken not to run over or tramp upon the clover after it is dried, as many seeds are thus shelled out and lost. The better plan is to haul to the thresher from the field just as soon as the straw is in a proper condition to thresh. This will save the trouble and expense and loss of handling it twice.

Some farmers prefer to sow seed in the chaff, believing that a better stand of clover is thus secured. Usually about thirty bushels in the chaff are considered equivalent to one of cleaned seed. Of course this will depend greatly upon the yield of seed, and experiments ought to be made to determine the relative amount to sow when in chaff.

It is a curious fact and one, I believe, first mentioned by Mr. Darwin, that the bumble bee plays an important part in the fertilization of this plant. Careful observation has determined the fact that the amount of clover seed gathered from a particular field will, other things being equal, be in proportion to the number of bumble bees that feed upon the flowers. In the act of feeding they gather the pollen from one flower and transfer it to the next one upon which they alight, thus acting as important agents in the fertilization of the flower, and consequently in increasing the production of seed.

CRIMSON OR SCARLET CLOVER—(*Trifolium incarnatum.*)—(Pastures and Hay.)

Within the past decade crimson clover has become a staple crop in some of the counties in Tennessee. It is an annual and grows to the height of three feet on good soils. Few things in the vegetable world present a more beautiful sight than a field of crimson clover in full bloom. It seems to be better adapted to southern climates than red clover and it has given satisfaction at the North Carolina Experiment Station and as far south as Louisiana.

Prof. Stubbs, of Louisiana, says: "It is thoroughly at home in every part of the State, making a large crop of excellent hay. A combination of this crop and cowpeas affords the readiest means of quickly restoring worn out lands or of furnishing a continual supply of fresh hay for stock."

A large area of this clover is sown every year in Franklin county, Tennessee, in the Belvidere settlement. In answer to inquiries Mr. Jno. Ruch, of that place, says: "We sow it in August or September, using two or three gallons of seed to the acre. It comes to maturity the last of April or first of May, when it is cut and cured for hay in the same man-

ner as red clover hay. I consider the hay as good, in every particular, as that made of red clover. Crimson clover has given excellent results in Franklin county."

The advantages of crimson clover are chiefly four:

Crimson Clover—Trifolium incarnatum.
(U. S. Dept. Agric.)

1—It is a good "catch" crop and when a failure of red clover occurs it may be sown upon the same land and so preserve the regular rotation.

2—After the clover has been cut in early May, the same land may be ploughed and planted in corn.

3—It makes excellent pastures during the fall months after the other green crops have dried up.

4—As a crop for green manuring it ranks high. It is turned under in the spring as it makes its growth during the fall and winter months. In this it differs from all other crops for green manuring.

At Belvidere it is sown on a deep clayey loam impregnated with more or less of the carbonate of lime, but it is not what may be called a calcareous loam. Crimson clover should be sown alone as it will need all the land. For the feeding of milch cows it is held in high esteem as it induces a full flow of rich milk. Growing as it does in the fall, it prolongs the season of green food and so increases the profits of the dairy. A co-operative creamery at Belvidere has its butter products largely increased from the general habit of the farmers in the vicinity of sowing crimson clover in the fall.

This forage plant deserves more attention from the farmers of the South for dairy purposes than it has heretofore received.

It will yield from three to ten bushels of seed per acre. Mr. Ruch says he has made both these extremes.

It is generally believed in those places where crimson clover has been sown for a number of years that though not equal to red clover it is a very good substitute. The farmers who have grown it once feel inclined to continue to grow it, especially when there is a failure of red clover.

A bulletin from the United States Department of Agriculture, recently issued, has this to say in regard to a possible danger in the use of crimson clover:

"The introduction of the annual leguminous plant, crimson clover, into the United States is comparatively recent, but its use as a forage plant and green manure is rapidly extending. This is easily explained by the decided advantages this clover possesses of covering and protecting the soil from washing and leaching during the winter, and of furnishing a green manure for spring crops or a succulent and nutritious food at a time when such food is likely to be scarce. It has been found, however, that there is a danger in the use of the overripe clover, especially with horses, that should be carefully guarded against. The small hairs which occur in the heads of the clover are so constructed (when the plant has passed the flowering stage) that they collect together and form large, round, impervious balls in the intestines of horses, and many cases have been reported in which these have caused the death of animals. When the balls have once developed to such a size that they cannot pass through the intestine no practical remedy can be suggested. But the prevention of the difficulty is in most cases easy. The hairs of crimson clover do not become stiff until the plant has passed the flowering stage and begun to ripen. It should be made a rule, therefore, never to feed crimson clover after the crop has ceased flowering, and especially never to follow the pernicious practice of feeding stock with the straw of crimson clover raised and threshed as a seed crop. By guarding against improper methods of feeding there is no reason why crimson clover should not continue to maintain its well-merited reputation and increase in use as a forage plant and green manure."

No reports from the farmers growing crimson clover in Tennessee make any mention of having lost stock directly or indirectly by feeding it.

Mr. J. Kaserman, a very successful farmer in Franklin county, Tennessee, who has sown crimson clover for many years, mentions one disadvantage of crimson clover hay, for horses especially, in the fact that the chaff causes a dust, which is injurious to horses. He, however, says nothing in reference to the formation of balls in the stomach of horses. Mr. Kaserman also says: "Crimson clover is sown in September or October and the usual amount of seed sown per acre is about ten pounds. It matures the following May, and ought to be cut for hay when it is in full bloom. The usual yield of hay per acre on good soil is from one to one and a half tons. I do not consider it as good as red clover in sustaining stock. If perfectly cured it keeps about as well as red clover hay, but being very sappy it is harder to cure. I do not consider that it has any advantages over red clover, but it is easier to get a stand of crimson clover than of red clover. It is sown alone or with winter oats to be cut together for hay. In this section the yield of seed has been from four to six bushels per acre."

BUR CLOVER—SPOTTED MEDICK—CALIFORNIA CLOVER. (*Medicago maculata.*)—(Grazing.)

Bur clover is admirably adapted to lowlands that are well drained. Sown in connection with Bermuda grass it is a great desideratum, inasmuch as it makes its principal growth during winter months and disappears just about the time Bermuda grass begins to grow. Both together make a continuous pasture for cattle and hogs. Horses, however, do not relish it. It is unfit for growing in any place where Bermuda grass will not thrive. In some of the lands on the Mississippi River it would be a valuable addition to the pasture plants. It is an annual and so must be sown every year, but is hardly so valuable as the crimson clover, because it will only grow on very rich soils and is not relished by all kinds of stock. It is worthless for hay.

ALSIKE CLOVER—(*Trifolium hybridum.*)—(Hay and Pasture.)

Linnaeus gave the specific name of hybridum to this clover because he imagined it to be a hybrid of the white and red clover as in its appearance it seems to be intermediate between the two. It is a perennial, has a slenderer stalk, a narrower leaf and paler colored flowers and foliage than red clover. The flower stalks are larger, the blossoms more fragrant and fuller of honey and for this reason it is sometimes sown by beekeepers for the making of honey. The blooms are faintly tinged with pink when they first open. Afterwards they deepen into a pale red. The seed is kidney shaped and is less than half the size of the seed of red clover.

It is a good idea to sow the seed with red clover, as, being a perennial, the clover will cover the ground when red clover runs its biennial course and alsike clover does not get its full strength until the third year after sowing. It does well also sown with orchard grass, for when sown alone the stems are so weak it is liable to fall and lodge. The sturdy culms of orchard grass will hold it up. It consorts well with herd's grass also.

This clover is not well adapted to dry, sandy or gravelly soils with porous or leachy subsoils. It prefers moist clayey soils. It does best in the climate of Tennessee on rich bottom lands, on deep clayey lands, and even in the swampy lands where the wild growth should be exterminated by plowing and the land thoroughly drained of its surplus water. It yields a very superior quality of hay and a great deal of it. A Michigan correspondent of the Western Rural mentions four tons of finely cured hay as having been cut from one acre of land where the soil had been deeply broken and the land was rich, moist and underdrained. It grows to the height of three and a half feet on such land and much thicker than red clover. It stands dry and cold weather better than any other clover, is not easily winter killed and is a great favorite with those who have tested it. In giving an estimate of its value the correspondent referred to, says:

"For soiling cows, horses, etc., when pastures fail, it is equal or superior to green corn, and attended with much less trouble in the gathering and feeding. During the past year, I cut three crops from the same ground, standing at the first cutting from two to three feet in height; last cutting one foot in height, as thick as it could stand, small, delicate stalks, with numerous branches, and perfectly glorified with a mass of small peach-blow colored blossoms, filling the air with the most delightful and exhilarating perfume, and swarming with bees every fair day. The root is like that of red clover, but longer and more fibrous. The haulm is small, tender and nutritious; when well cured, as it should be, in full bloom, every part will be eaten with avidity by all kinds of stock.

There is no plant known that will produce so much good honey, butter, cheese, beef, mutton, wool and hay per acre, as this plant, not even excepting corn. In using the latter for soiling, you get only the haulm, while in the alsike you get the haulm and a large yield of honey; and if the ground is prepared as well by deep tilth, manure, and plaster or other fertilizers, as for corn, you will get as much by weight of the haulm.

It bears feeding to an enormous degree. I think its fattening qualities superior to the famous blue grass of Kentucky, and as it will flourish well on such soils as I have designated, from the Gulf to Lake Superior, farmers can easily divine its immense advantage to their pockets. Besides, the expense of 'seeding down' every three or four years is saved. It is a great renovator and disintegrator of hard, tenacious soils. Its long tap roots and numerous fibres reach deep for its pabulum, and thus loosen the soil and endure drought well. Some think there are two kinds of this clover. I think not. The difference in growth, etc., in diverse localities, is owing to the character of the soil. I never saw any but the large kind on land once covered with beech, maple, oak, bass, lever wood, etc., and I never saw any but the small kind on light, sandy and gravelly soils. Also on pebbly soils with calcareous debris and good tenacious subsoil it succeeds well."

This clover is very prolific in the yield of seed. From three to eight bushels are usually gathered per acre from a good stand. The yield will average probably five bushels per acre. In its capacity for seeding land this is equivalent to about fourteen bushels of red clover seed, as the

proportions are 16,000 of red clover and 45,000 of alsike clover seed in an ounce. The seed varies from a dark green to a violet color; weight 94 to 100 pounds per bushel.

The farmers of the South would do well to try this species of clover by sowing it with red clover or herd's grass in the spring of the year upon bottom land, and upon mellow and moist, well-drained clayey soils. The many moist bottoms along the streams would suit it. The valley of East Tennessee offers some excellent soils for its growth as well as the Highland Rim of Middle Tennessee, and the uplands of Northern Alabama and Georgia.

WHITE CLOVER—(*Trifolium repens.*)—(For Pasture.)

This hardy species of clover grows in almost every part of the United States and Europe. It is said to be the shamrock of Ireland. Various estimates have been made as to its value, many persons claiming that it is totally worthless, while others place it among the most valuable of the grazing plants. In Tennessee it unquestionably stands next to blue grass for pastures. It is to the pasture what red clover is to the meadow. All stock, even hogs, will fatten on it, but after its first inflorescence it salivates horses. To the beekeeper it is very valuable, being one of the best honey-making plants in the South.

It is rarely sown in any of the states, but it comes up spontaneously, sometimes almost disappearing one year and in another year completely covering the pastures and yards. Farmers often speak of white clover years and this is due to the prevalence of early rains in the spring. Whenever blue grass is pastured too heavily white clover comes to its relief and supplies good grazing during the dryer months of summer. It will grow on almost any character of soil, sterile or fertile, cold or warm, moist or dry. It is virtually a perennial plant, which gives it a great advantage as a pasture grass over red clover. Analyses have determined its highly nutritive qualities. It is said to be richer in these than blue grass. It is not fit for a meadow as its dwarfy growth makes it difficult to cut, though hay made from it is said to be excellent. A good pasture of white clover is by no means to be despised by thrifty farmers. The seed may be bought from seed stores and sown at the rate of about one bushel for twelve acres.

The time of sowing is the same as that for red clover.

SAINFOIN OR ESPARCET (Century Diet)—(*Onobrychis sativa.*)—(Hay.)

This is a perennial leguminous plant resembling the pea more than it does clover. It has straggling, smooth, tapering stems from two to three feet long. Its flowery stalks are higher than the leaves, ending in a spike of crimson or variegated flowers. This is what the French call a sacred grass and is considered more valuable in that country than almost any other.

It will grow upon dry calcareous soils, which are too sterile for growing either clover or alfalfa. The soil must be well drained for it dies whenever the ground becomes saturated with water. Sainfoin requires two or three years to arrive at maturity and is rather difficult to

establish because the plants are very delicate when young, but when once established it will last a score of years.

Instances are given in France where it has lasted on a single piece of land, with rich soil, a hundred years. The yield of hay is not so great as that from red clover or alfalfa, but it is of a very superior kind and is more nutritious than that of red clover. It is highly valued as a butter-making hay and its seeds are said to be superior to oats for feeding stock and more nutritious. They are excellent for feeding to poultry to incite them to lay.

Sainfoin will stand a large amount of heat though it is sensitive to cold. The writer has seen it growing in Stewart county, Tennessee, having been brought there by a Swiss family. It would probably grow well in all parts of the South, especially on dry soils. It requires two bushels of seed, as usually cleaned, for sowing an acre and it should be sown from the first of May to the end of June on well prepared land. In order to insure germination the seed must be covered with a harrow. When very clean seed are used half as much as has been indicated will be sufficient.

In all those places where the ground is too dry or too sterile for growing red clover, sainfoin might be introduced with profit. Possibly it would do well upon the benches of the Cumberland mountain and upon the siliceous soils of the Highlands and on the high ridgy lands of East Tennessee where there is some lime in the soils.

Sainfoin will make from ten to twenty-five bushels of seed per acre, forty pounds being the weight of a bushel.

For pasturing it is not a very desirable plant, as it does not have the ability to withstand tramping as well as red clover.

MELILOTUS—SWEET CLOVER—(*Melilotus alba.*)

This forage plant is highly commended as a restorative crop for calcareous soils. It acts also as a drainage plant. The roots descend to the depth of several feet, and, being large, they supply innumerable downward drains for carrying off stagnant water. This gives warmth to the soil and permits the roots of succeeding crops to descend to a greater depth in search of food.

The writer has often grown this in a small way in a garden but his experience is that no stock will eat it. It makes a splendid growth upon rich soils, attaining the height of six feet or more. It starts very early in the spring and soon becomes a conspicuous object with its bluish green foliage. It is said by observant writers that stock will soon learn to eat and relish it. It is a biennial, but it makes a very luxuriant growth the first year and two crops of hay may be harvested during the summer succeeding the spring in which it is sown.

Prof. S. M. Tracy, of the Mississippi Experiment Station, says: "While the hay from this plant will not sell as well as that from Lespedeza, the crop is heavier, furnishes pasture earlier in the spring, and is by far the most valuable crop we have for a natural fertilizer. Seed must be sown in August or February at the rate of half a bushel to the acre."

Whether this plant is suitable for feeding stock or not there is no doubt it is an excellent plant for building up worn-out soils, and for this purpose, if for no other, it may be recommended to the farmers of the South for restoring fertility to lands of a calcareous nature. It has a dense foliage; it grows rapidly; its roots are abundant; it has the capacity like clover of gathering nitrogen from the atmospnere; it is more hardy than clover and it is much easier to secure a stand upon run-down soils. It therefore supplies a want for some localities where the land needs humus and an increased supply of nitrogen.

If the statement that stock soon learn to love it is true, it makes it still more valuable to the farmer, for the immense amount of dry forage which can be made from it when grown upon soils even of moderate fertility, is almost incredible.

ALFALFA OR LUCERN—(*Medicago sativa.*)—(Hay.)

Alfalfa, or lucern, stands unrivalled among all the forage plants for its abundant yield, its longevity, its hardiness when once established, its extended habitat and its great antiquity. From the vast highlands of Western Asia it was introduced into Greece at the time of the Persian War, 470 years B. C. It was cultivated extensively by the Romans, was carried into France probably when Caesar invaded Gaul, and then into Spain. From Spain it came to Mexico and then to South America, and from South America to California. It was introduced into New York before it was brought to California.

Alfalfa is now cultivated to some extent in every State and Territory in the Union, and in every State and Territory it has met with more or less success. Wherever it has been well established it has received great favor. It is a child of the sun and revels in heat that would destroy any other species of clover. Its nutritive elements are almost identical with those of red clover. It has one advantage, however, of red clover, in that it is a perennial plant. It does not at all resemble clover in its appearance. The purple pea-like flowers are in long, loose clusters or racemes, and are scattered over the entire plant.

Alfalfa—Medicago sativa. (U. S. Dept. of Agric.)

SOILS ADAPTED TO ITS GROWTH—Alfalfa does not grow well on any soil that has a hard pan or on thin soils. It is a deep rooted plant and must have a deep soil. Wherever the roots find a permeable soil they will descend to a great depth and on river banks they have been traced to the depth of 60 or 70 feet. On the rich sandy soils of the South it is invaluable, and will grow luxuriantly and make enormous yields of hay. Underlying rocks or impervious subsoils, or sour, marshy soils, or crawfishy soils, or stiff, clayey soils are fatal to its growth. So is stagnant water. It will grow on favorable soils at almost any height from sea level up to an elevation of 7000 feet.

Alfalfa is not affected so much by altitude as by the depth and warmth of the soil and the depth of the water-table beneath the surface. A rich, sandy loam, limy with a porous subsoil suits it best. A region in which the rainfall is excessive is not favorable for the growth of alfalfa as the plants are quickly killed even by surface water. Nor is the presence of a large proportion of iron in the soil favorable to the growth of this plant. Soils that have a large content of lime, phosphoric acid, potash and magnesia are those best adapted to its growth, but lime seems to be the most essential. A considerable amount of sand in the soil is not objectionable.

HOW TO PREPARE THE SOIL—The soil should be prepared in the most thorough manner. It must be finely pulverized; it must be broken deeply and subsoiled and it must be free from any trash or weeds. It is better to sow alfalfa after some hoed crop, as tobacco, cotton, potatoes and root crops such as beets, carrots, turnips and rutabagas. In the middle South the seed may be sown in the fall or spring. October and March are the best months. It is best to sow the seed in drills from 15 to 20 inches apart. Twenty to twenty-five pounds of seed per acre will be required. When the plants have come up and grown high enough a small cultivator should be run between the rows so as to destroy any grass or weeds that may have made their appearance. Many persons sow the seed broadcast but if this is done it must be upon land that has been kept free from any noxious weeds by crops or clover.

Alfalfa when young is an exceedingly delicate plant and requires much nursing. It is sown by some persons with oats or wheat but in the climate of Tennessee when so sown the young plants rarely survive the summer heat. No crop requires more extraordinary preparation to secure a good stand than alfalfa, but it should be remembered that one preparation will last for a generation. for if it is planted upon suitable soil and a good stand obtained it may yield luxuriant crops for thirty or forty years. It rarely happens that alfalfa will grow tall enough the first year or will be sufficiently free from weeds to be mowed for hay, yet if it has been sown broadcast in the spring it will be wise management to run the mower over the land as often as weeds and grass may grow high enough to cut. It reaches its best growth during the third year. When properly managed up to that period the number of cattle which can be kept in good condition on an acre by soiling throughout the whole season surpasses belief. It is no sooner mown than it pushes out fresh shoots, and wonderful as the growth of clover sometimes is, that of alfalfa is far more

rapid. Upon soils suitable for it it will last for many years, shooting its roots—tough and fibrous almost as those of liquorice—downward for nourishment, until they are altogether out of the reach of drought. In the dryest and most sultry weather when every blade of grass droops for want of moisture, alfalfa will hold up its stems as fresh and green as in a showery spring.

Alfalfa has been fully tested in Tennessee, Georgia, Alabama and Kentucky, and has given great satisfaction. Horses are very fond of it, and it is claimed by many that they require no other food, except when they have been at work. Five tons of good hay may be made to the acre. It is estimated that five horses may be supported during the entire

CUTTING ALFALFA.

year from one acre of alfalfa in full growth. It is ready for the mower a month before red clover, and springs up long before the usual pasture grasses.

ALFALFA FOR PASTURE—Alfalfa is indifferently suited for pasture. The tramping of stock upon the land compacts it so much that the plants rapidly deteriorate. It is often pastured in the west but rarely when it is intended for making hay, as, when once pastured, so many roots are destroyed as to greatly diminish the yield of forage. It is, however, extensively used as a pasture for hogs and they do not seem to injure it as much as heavier stock. One acre of alfalfa will furnish abundant forage for ten to twenty hogs throughout the season. It is a great pork producer.

Mr. Jared G. Smith, the Assistant Agrostologist of the United States Department of Agriculture. states that ten pigs put on a field of it will gain 100 pounds each during the season from May to September. He says that pigs will come out of the field in autumn in capital condition to fatten with corn or small grain. For a hog pasture alfalfa should be mowed once or twice during the summer so that young and tender herbage may be supplied, which is more nutritious than the forage from older plants.

ALFALFA HAY—It requires much skill to properly cure alfalfa hay. Being ranker usually than red clover, and cut when the first blooms begin to appear, it is full of sap and must be managed with great discretion and judgment. The best method of saving the hay is to cut it in the morning after the dew has been dissipated. It should lie in the sun until it is wilted, then raked into windrows; after remaining for 24 hours it may be carried to the barns or open sheds, or stacked in the field. It should be handled just as little as possible. It sheds its leaves much more easily than red clover and, as the leaves are the most nutritious part of the hay, handling greatly impairs its value.

In wet weather it is very difficult to save alfalfa hay without moulding. If a rain should fall upon it, while in the windrow, hard enough to pass through it, it should be shaken up just as soon as the sun comes out, but the sun does great damage to it by drying the leaves and so causing them to shatter when the hay is being handled. Therefore the best plan in such a case is to throw the windrows into small cocks before the leaves are thoroughly dry, but these cocks must be small enough for the air to circulate through them. A hard rain will diminish the value of the hay, under any circumstances, fully one-half. If very much injured it should be used as a top-dressing. It will be more valuable employed for this purpose than for hay. In sub-tropical regions the hay may be cut seven or eight times a year. The writer has seen it growing in the northern part of Mexico with such luxuriance that it seemed almost impossible for an ordinary mower to cut it. In the State of Chihuahua, upon bottom lands where alfalfa is irrigated after each cutting, the yield sometimes reaches fifteen tons in a single year. It is cut every four weeks and the seasons last from February to November. With the stimulating effects of heat and moisture upon the rich soils in the valleys of that region the amount of hay which may be obtained from a single acre is often great enough to supply the demands of a considerable ranch. Alfalfa hay is rich in protein but it is deficient in fat and carbohydrates. It is therefore recommended that some of the coarser fodders, such as wheat or oat straw, millet or root crops, be added to the feed. Prof. Smith says that "one ton of alfalfa hay and three tons of green fodder will furnish food for one milch cow of a thousand pound weight for 136 days without notable loss of any of the digestible compounds in the forage."

There is no better hay, however, for all kinds of domestic animals and especially for young and growing cattle and horses, and for sheep. Alfalfa is well adapted to the use of persons living in small towns or villages who have a lot they wish to devote to hay for a horse and a cow. No other kind of forage crop will equal it in the quantity and quality of

its produce, for all experience has demonstrated that it is as good as the best. From such a lot alfalfa may be cut green and fed every night and morning. Care must be taken, however, not to feed too much, or to feed it to cattle when it is wet, as it is liable to produce bloat or hoven. Sheep are also liable to be affected in the same way, but horses and hogs are not.

Prof. Smith warns the orchardists against planting it in an orchard. The roots descend so much deeper than the roots of the fruit trees that the latter are often killed. It is a good forerunner for an orchard because the roots penetrate the subsoil deeply and in their decay furnish an excellent fertilizer for fruit trees, inasmuch as the alfalfa roots have the power to collect nitrogen from the air just as other leguminous plants, and the field is greatly enriched.

In an analysis of the soils upon which alfalfa is grown it is found that they differ widely in their chemical composition. However, the carbonate of potassium and the carbonate of lime are usually the most abundant ingredients, followed by the phosphate of lime. In clayey and chalky soils the carbonate of lime reaches nearly 50 per cent. Alfalfa will produce the largest quantity of forage for domestic animals and will, at the same time, enrich the lands upon which it is grown.

COW PEAS—(*Vigna catiang.*)—(Pasture, Ensilage and Dry Forage.)

No agricultural product of the South has come so rapidly into well merited and almost universal favor within the past twenty years as cow peas. Though they were introduced into South Carolina over 150 years ago it is but within recent years that they have been grown in all the Southern States. They are now a staple crop in the border states and are grown in every portion of them. Twenty years ago their cultivation was confined mainly to the cotton growing districts, but at present they have taken to a large extent the place of clover, and especially where the lands have become "clover sick," or the clover crop uncertain. Cowpeas, in fact, richly deserve to be called the "clover of the South." It is a leguminous plant and appropriates nitrogen from the atmosphere as all other plants of the same family do. They supply as much humus to the soil as clover, and may be successfully grown upon soils that are so sterile clover would wither and die on them.

There are many varieties or subvarieties of the cowpea. These varieties often take local names derived from the persons who introduced them. The best established varieties for the Southern States are the eureka No. 1, the unknown, clay and black; in the Central and Northern section the eureka No. 2, black, black eye, whippoorwill and Carolina. Some of these are bunch varieties and some trailing or climbing.

SOILS FOR COWPEAS—One of the greatest advantages which the cowpea possesses over every other forage or fertilizing crop grown is its adaptability to every soil. The writer has seen it growing with strong foliage upon a dozen different soils in the State of Tennessee. Some varieties seem to prefer one soil, and some another, but all varieties will make a satisfactory growth upon any soil. But the cowpea is especially valuable for dry sandy soils, inasmuch as clover rarely does well upon such soils.

The peas may be sown at any time from the first of May until the last of July. It takes from sixty to eighty days for them to mature. The soil may be prepared by breaking it with a two horse plow. The peas should then be sown at the rate of one bushel and a half per acre and the ground afterwards well harrowed. Some farmers prefer to drill the peas in rows two and a half to three feet apart, the peas being at intervals of one or two inches in the row. After they have come up a cultivator should be run between the rows. Peas furnish a large amount of feed when planted between the corn rows at the last plowing of the corn. The bush varieties ripen soonest but the California cowpea, the clay pea and the black pea are more profitable as they do not rot so readily in wet weather and will remain sound and keep a large number of stock the best part of the winter after the corn has been gathered. The whippoorwill pea planted by itself will give the earliest returns.

Stubble ground after oats or wheat is turned to good account by breaking and sowing it with peas. The pasture comes on at a time when it is most needed. In the southern part of Tennessee and in Northern Alabama a crop of peas grown on stubble land goes a long ways towards fattening hogs for slaughter.

COWPEAS FOR HAY—It is generally conceded that when properly harvested and cured cowpea hay is the equal of red clover hay in every particular and indeed much richer in protein. The only exception to this general admission as to the value of cowpea hay comes from the Kansas Experiment Station, where it is reported that stock would not eat the vines green, cured or in ensilage.

Recent experiments at this Experiment Station go to show that in two tons of timothy hay and in three tons of cowpea hay, each the product of one acre, the following results were obtained:

FERTILIZING MATERIALS.

NITROGEN	PHOSPHORIC ACID	POTASH	WORTH
Timothy—25 lbs. at 12 cts.....	10 lbs. at 5 cts.	18 lbs. at 5 cts.	$4.40
Cowpeas—58 lbs. at 12 cts.....	15 lbs. at 5 ct...	40 lbs. at 5 cts.	9.71

FOOD MATERIALS.

	PROTEIN	CARBOHYDRATES	FATS
Timothy	118 lbs.	1500 lbs.	50 lbs.
Cowpeas	500 lbs.	1700 lbs.	87 lbs.

"We see, thus, that legumes furnish three to four times as much protein and more carbohydrates and fats than common hay. They contain over twice as much nitrogen and twice as much potash. This nitrogen is derived from the air, and removing it does not deplete the soil. The best plan is, thus, to feed leguminous plants and return to the soil the manure, which will still contain four-fifths of all the fertilizing elements. As nitrogen of the air is the cheapest source of nitrogen for plants, so it

is the cheapest source of protein for animals. Soiling is a good plan for dairymen. Save the manure. Grow more legumes. They furnish the cheapest manure for the soil and the cheapest food for stock, because they obtain from the air the nitrogen necessary for plants and animals, which costs 12 to 15 cents a pound."

The director of the Delaware Station testifies that in one experiment the yield of dry hay per acre was 2353 pounds, which contained 58 pounds fat, 147 pounds ash, 320 pounds protein, 1596 pounds fibre and carbohydrates and 232 pounds of moisture. Comparing it with wheat bran it was shown that the bran leads in fat, but in all other respects the dried vines excel.

"The proper stage for cutting peas for hay," says the Hon. H. M. Polk, "is when the first pods begin to turn yellow and while the leaves are green and the stems soft. The greatest care must be exercised in curing cowpeas for hay. The vines are full of moisture and they will not shed water. They should be cut in clear weather after the dew is off and treated very much as clover when cut for hay. The great end to be accomplished is to cure the vines to the extent of getting rid of a part of the moisture without having the leaves burned by the sun. When exposed too long to the sun the leaves become dry, fall off the stems and are lost. When put up too green and too compactly, they heat, and when fermentation of the juices in the vine and unripe pods occurs, the hay is seriously damaged, if not completely spoiled. Mildewed hay of any kind is very poor food for stock, and when eaten at all it is only taken from necessity to ward off starvation. Some planters house their pea hay in open sheds, or loosely in barns, with rails so fixed as to prevent compacting. Others stack in the open air around poles on which are left limbs from two to four feet long, to keep the mass of vines open to the air. The top of the stack must be covered with hay or straw that will shed water."

COWPEAS AS A SOIL RESTORER—Not even clover surpasses the cowpea as a soil renovator. The most badly worn and abused soil may be quickly brought to a condition for profitable production by planting a succession of pea crops upon it. Nor are the best results obtained by plowing under the pea vines when green. Careful experiments made at the Georgia Station show:

(1) That the best disposition of a crop of field peas is to convert the vines into hay.

(2) The next best is to permit the peas to ripen and gather them (or pasture them.)

(3) Turning the pea vines under green gave the poorest economic results.

To which the director adds the following note:

"It may be truly said that the practice of turning under a crop of cowpea vines—ready for the mower, and in a few days for the barn and for the cattle—has no more reason to sustain it than would the practice of turning under a crop of wheat, oats, corn or cotton at its most vigorous stage of growth. Nearly every form of stock food would be a valuable and effective fertilizer if applied immediately and directly to the soil; but the farmer in an economic sense can no more afford to manure his soil

with a crop of pea vines that are ready to mow, than he can to sow good, sound wheat bran on his land as a fertilizer."

Of the capacity of the cowpea as a fertilizing agent Prof. Stubbs, of the Louisiana Experiment Station, says:

"Valuable as this plant is for its vine and fruit as food, its superlative excellence lies in the property which it has of restoring worn soils. This property it shares with all leguminous plants, but it surpasses them all in producing the maximum results in a minimum of time. Clovers, trefoil, lupine and alfalfa are used in different countries as soil renovators. They are planted in the fall or spring and occupy the ground the entire season or longer for good results. In the South the cowpea is planted in the late spring or early summer and the crops of vines or peas are harvested or buried for fertilizing purposes in early fall. The growth and development of this plant is both rapid and enormous, particularly when planted on good land. It perhaps assimilates more plant food in a short time than any other leguminous plant.

This plant in common with all others of the pulse family, assimilates the nitrogen of the air and if phosphates, potash and lime be present in the soil, it will grow with great rapidity and luxuriance. The manner of assimilation of nitrogen has recently been patiently investigated by scientists, and while the exact process by which it is accomplished is not yet clearly understood, the primary cause is clearly shown. If a farmer will pull up carefully, with its roots, a pea vine plant from his field, and examine closely each rootlet, he will, if he has selected a healthy growing specimen, find each one covered with wart-like protuberances or tubercles. These tubercles, if examined under a powerful microscope, will be found filled with micro-organisms called bacteria. They are living on the plant and are drawing from it the mineral matter requisite for their existence. Simultaneously, however, they are assimilating the free nitrogen of the air which reaches them through the porosity of the soil. These bacteria have a very ephemeral existence but great facility for rapid multiplication. Hence millions die every few moments. This living together of the plant and its seeming parasite, each acting as a purveyor of food for the other, is a most remarkable discovery made almost simultaneously by Dr. W. O. Atwater of this country, and Hellriegel of Germany. While it has long been known that leguminous plants had these nodules on their roots, and longer still that they were in some way nitrogen gatherers, and therefore soil improvers, yet the relations between these nodules and the plant were determined only a few years since by these distinguished scientists."

Much more might be written to show the great value of the pea crop. Summing up its chief merits we have:

1—The pea will thrive upon every variety of soil and will grow on land too poor to grow clover.

2—It will produce a heavy and rich crop to be returned to the soil in a shorter period than any other green manuring crop.

3—On the same land in one year two crops can be grown, but it requires two years for clover to produce a hay crop, so it will be seen that four crops of peas may be grown in the same time as one crop of clover.

4—The pea crop feeds lightly upon the soil but largely upon the at-

mosphere, appropriating nitrogen through the agency of the bacteria that infest its roots.

5—It is one of the best preparatory crops for wheat, as it leaves the soil in excellent condition, adding a large content of nitrogen which is an essential element in the growing of wheat.

6—The rapidity of its growth makes it the only crop in the South that may be used as a manurial crop between the harvesting of grain and the sowing of it on the same land.

7—It grows as vigorously as clover and in connection with that plant makes the South peculiarly rich in those vegetable agents that improve the soil.

8—It may be grown in connection with the corn crop, furnishing almost as much nutriment as the corn crop itself, with a positive benefit to the land.

9—It is a substantial factor in the production of cheap beef, pork, milk and butter.

10—It doubles the capacity of the land for wintering stock, and gives double the material for making manure heaps.

11—The galled and waste places in the South can be more quickly and cheaply restored by a judicious cultivation of the pea, and by proper rotation of other crops with it, than in any other way.

12—By adding humus it preserves the humidity of the soil and so enables the crops to resist droughts.

13—The vines of cowpeas furnish the very best material for ensilage.

14—The composition of cowpeas and pea vine hay shows that they have a very high feeding value for all domestic animals.

PEANUTS—(*Arachis hypogaea.*)—(Forage for Cattle and Seed for Hogs.)

Peanuts have long been a staple crop in some portions of the South. They were introduced into Tennessee from North Carolina about sixty years ago and for a long time the crop was regarded as one of the most profitable that was made in the State. Within recent years, however, the price has fallen so low that the quantity raised has sensibly decreased.

Two varieties are grown in Tennessee, the red and the white.

The red is an upright grower and produces a small nut, the epidermis or outer coating of which is dark red in color.

The white grows with spreading branches that lie flat on the ground. These branches bear peanuts almost throughout their entire length. It is highly important in growing white peanuts to have the land very mellow so as to permit the bearing "spikelet" to penetrate the ground. The white peanuts command a better price than the red. The pods are larger and whiter and present altogether a much better appearance.

A few Spanish peanuts are grown in places. They are earlier than the other varieties and have an upright growth like the red. They mature a larger proportion of the nuts, so that, though the nuts are small, there are fewer inferior nuts or "pops." There is another advantage which is claimed for this variety and that is that the pods cluster around the vines so closely that when the vine is pulled up nearly every nut clings to it,

making the loss very inconsiderable in harvesting. The flavor of the Spanish nut is very delicate and the kernel does not differ materially in chemical composition from the Tennessee nut. except in its larger content of water. Many people, however, prefer the larger nuts and so these usually outsell the Spanish peanut, but the Spanish variety is a much surer crop. When the white variety by reason of bad seasons makes a comparative failure, the Spanish peanut often makes a large yield and it is also more valuable for the feeding of hogs than the white peanuts. It is said that when it is planted in Tennessee in a few years it grows as large as the Tennessee nut. Extremely warm weather is not necessary for the fruitage of the peanut. Cool weather will cause the pods to form as readily as the hottest weather in July. It requires five months to mature the white variety. The Spanish variety will mature in about four months.

The best peanuts are planted early and therefore an early spring is desirable, with no beating rains, especially if the land is strongly argillaceous, for when the ground is baked the delicate young stem cannot penetrate the hard crust. A bad stand then results, which is scarcely to be remedied by replanting. The regions growing the best nuts for eating are embraced in Virginia, Tennessee and Kentucky. The extreme Southern States grow the peanuts fully as well as the states mentioned, but they contain so much oil as to impair their flavor and make them more indigestible. On the other hand, when grown in the far South they are better for fattening purposes, and far better for making peanut oil, which is now regarded as one of the most valuable of the oil products.

Peanuts have been successfully grown in Tennessee for many years in the counties of Perry, Hickman, Humphreys, Dickson, Lewis and Wayne, situated in that natural division of the state known as the Highland Rim, and in a few counties in West Tennessee.

THE BEST SOIL.—The best soil for the peanut is a light colored clayey soil, filled with finely-comminuted, cherty, angular gravel, which makes the ground loose and prevents it from baking. The ground should be well drained and light in color, for it is a singular fact that there is a correlation between the color of the soil and the color of the nut, black or deep red soils making a dark colored nut and light or whitish soils a light-colored nut. The darker soils may, and most frequently do, make a larger yield per acre but the nuts do not command such a good price and are classed in a lower grade.

Land with much humus is not suited to the growth of peanuts. The soil should be strong but with a small amount of vegetable matter in its composition. Peanuts, therefore, do not yield well after clover or in freshly cleared lands. In such conditions the amount of vine is excessive and such land is best for growing peanut hay, but the quantity of good peanuts is very small. The best results are obtained by planting the crops after corn or tobacco or potatoes, or after any crop that requires clean cultivation.

TIME AND MANNER OF PLANTING—The land for peanuts in Tennessee is usually prepared during the latter part of April after the danger of frost is passed. It should be well broken and finely pulverized

with a harrow. For white peanuts or the spreading variety the land is checked off in rows two and one-half to three feet apart, and two kernels, after being carefully hulled by hand, are dropped at the points of intersection of the furrows like corn and covered with a hoe to the depth of one and one-half to two inches. In shelling the nuts care must be taken not to break the delicate covering that surrounds the kernels, for this will impair or totally destroy their vitality. If the land after planting should become compacted by a hard rain, a light harrow should be run over it when the land is dry enough to plow, in order to break the obstructing crust, so that the very delicate shoot can make its way to the surface. Red peanuts are planted in ridges like cotton. The rows are run off three feet apart and four furrows thrown on these. The ridges thus made are opened on top by a bull-tongue plow or coulter and the seed dropped at intervals of eight to twelve inches apart and covered two inches deep by a board like that employed for covering cotton seed, or it would be better to procure a one-horse corn planter, adjusted so as to open the ridges to the proper depth and to drop the kernels at the required intervals, and at the same time, cover them. About two bushels and one-half in the hull are required to plant an acre. The brown millipede, the cutworm, the wood mouse, and the mole are all great enemies of the peanut when just planted. Replanting should begin, if the plant does not appear above ground, in ten days.

FERTILIZERS—Many peanut-growers object to the use of any manure whatever, but in this they undoubtedly commit an error. The application of a large amount of stable manure would prove detrimental, but in small quantities it is highly beneficial. The best fertilizer for the peanut is an ammoniated superphosphate of lime with some potash. An application of lime in its caustic state on other than limestone soils during the fall previous to planting would be beneficial. The peanut must have lime, but not too much of it. The heavy limestone soils will produce a great quantity of pops. No top-dressing of lime of any kind should be made. The superphosphate and the nitrogenous manures may be strewn in the furrows at the rate of 300 pounds to the acre. Ashes or kainit will supply potash, and a greater amount than 150 pounds to the acre is not necessary. Cottonseed meal and barnyard manure in limited quantities are excellent fertilizers for this crop. Being a leguminous plant the peanut has the power of extracting nitrogen from the atmosphere

CULTIVATION—If the land has been well prepared before the peanuts are planted the after-cultivation is very simple and inexpensive. The weeds should be kept down by using a narrow harrow or a double cultivator. Many growers use a one-horse turning plow and bar off the soil from the peanuts when they first come up. Afterwards in the cultivation of the white peanut this middle ridge is leveled down with a harrow or double shovel. For the red or upright growers the dirt at the second plowing is usually thrown back to them, if they have attained a height great enough not to be covered up by the process. The peanut will thrive with the same cultivation that is given to corn. Any cultivation is good that will destroy the weeds and keep the land in good tilth, but it must

not be extended beyond the period when the peanuts begin to form, and especially must this caution be observed in the case of the trailing or white peanuts. Level cultivation is far better for the white peanut and equally good for the red.

Many years ago it was thought that a necessary requirement in the cultivation of the white peanut was to cover the bloom. This practice has long been discontinued, for it not only does no good, but it does much damage and decreases the yield of the crop. The "spikelets" form above ground after the fall of the flowers, but the ground should be soft enough to permit the sharp thorn-like points to penetrate the surface. When once beneath the surface the ovary at the end of the "spikelet" begins to enlarge and ripens into a pale, yellowish, wrinkled pod, slightly curved, sometimes contracted in the middle, and containing generally two, sometimes three and rarely four kernels. A dry spring is always desirable for planting and cultivating, but when the "spikelets" begin to push down into the ground frequent showers are indispensable to a large yield.

HARVESTING—The harvesting must always take place before frost, for the nuts and haulm are both greatly injured, if not ruined, by frost. If the fall should be wet, or the peanuts mature very early, many of the first formed nuts will be ruined by sprouting. Dry weather should always be selected for harvesting. It cannot be done when the ground is wet, for then the dirt will adhere to the nuts and ruin them or at least greatly detract from their market value by injuring their color.

The crop of white peanuts is harvested by running a furrow on each side of the row with a bull-tongue plow or a pea-digger, so as to dislocate the roots. Care must be taken not to detach the nuts from the vine in running the side furrow. After the plow has been run on each side of the row (and it is sometimes necessary to run twice on a side) then lift the vines gently with the hand, carefully shaking the dirt off, and lay them on the ground. Let them remain in this way, if the sun is shining, from six to eight hours. The vines will wilt like clover, when they may be brought together and stacked. The stacks are made around a pole planted in the ground and rising some eight feet above the surface. A platform made of old rails rests upon logs placed around the pole and upon this the stack is built. The platform protects the nuts and vines from the mold and dampness of the ground. In stacking, the nuts should be put on the inside next to the stack-pole, but not so close as to prevent the air from circulating freely from the bottom to the top of the stack. To make the stack entirely secure it should have a capping of hay or corn fodder. Put up in this manner the nuts will keep securely all the winter should it be desired.

The red nuts are more easily harvested than the white, as they have but few roots and the nuts adhere closely about the stem. In loose land they may be pulled up without running a furrow on each side of the row, though to do this will make the work much easier. There are but few red nuts now grown in Tennessee. An over-production of them for a few years reduced prices below the cost of the labor required in producing them.

Usually the nuts are allowed to stand in the stacks about four weeks

and are then picked off by hand, the white nuts always. The red nuts are sometimes threshed off by taking up bundles and beating them against a rail or the side of a box. This latter plan greatly injures the nuts. Five to six bushels of red peanuts can be picked off the vines in a day by a nimbled-fingered person, but the picking of three to four bushels of the white is considered a good day's work. Women and children are said to be much more expert in this work than men. The price paid for picking is about ten cents a bushel. After this they ought to be screened in a cylinder so as to separate them from the dust and leaves and also for the purpose of brightening the hulls by abrasion. After sunning they are put in sacks containing four to five bushels. So much may be added to the selling price of the peanut crop by proper cleaning and assorting that it has been found profitable in all localities where many peanuts are grown to erect great recleaning houses. These houses are four stories high. The upper or fourth floor contains a large hopper into which the peanuts as they are delivered by the farmers are poured. They run down through pipes to the third floor, where they pass through a screen or cylinder and by abrasion the nuts are cleaned and the hulls brightened. From the cylinder the nuts are carried to the second floor, where they are passed through a fan by which the light ones are blown out. The heavier ones are caught on an endless belt passing longitudinally over the surface of a long table. On both sides of the table employes, usually girls or boys, stand and pick out all black or discolored nuts. At one end of the table is a sizer, where the nuts are separated into three classes: Jumbos, or fancy, which are very large nuts; No. 1 and No. 2. On the lower floor all grades are caught and sacked. The puffs and black or discolored nuts are shelled and sold to confectioners. The owners of the recleaning establishments buy the nuts direct from the farmers and resell them on the market after they have been cleaned and assorted.

YIELD PER ACRE—The weight of a bushel of peanuts in Tennessee is twenty-three pounds; in Georgia twenty-eight; in North Carolina and Virginia twenty-two pounds. The Tennessee peanuts are larger than those of Georgia and smaller than those of North Carolina and Virginia. Of those raised in Tennessee, less than one-fourth are of the red variety. The usual yield per acre is from thirty to fifty bushels, though as high as 100 bushels are sometimes made. The white peanuts will make from ten to twenty bushels per acre more than the red, but not being so easily cultivated or gathered, they were until recently considered less valuable as a crop.

USES OF THE NUT—The present consumption of peanuts by the American people for eating purposes alone reaches 4,000,000 bushels. This is largely in excess of what we produce. It is estimated that the peanut crop of the world now amounts to 600,000,000 pounds or 26,087,000 bushels. Much of this product is used in the Old World for making oil, which is regarded as an excellent substitute for olive oil, as it has an agreeable taste and odor. The shelled nuts will yield about 40 per cent. of oil. It is said that the Tennessee nut yields an oil that is often used and is highly esteemed for culinary purposes. Estimating that the hulls of the peanuts make 6 per cent. by weight and that 40 per cent. of oil may

be extracted from the kernels, there should be obtained 8.65 pounds of oil from each bushel of twenty-three pounds. This would give in liquid measure 1.15 gallons, which at the price of $1 per gallon, would make $1.15 for the oil extracted from one bushel of peanuts. Manufacturers use this oil as a substitute for olive oil in fulling cloth. A large amount is used in the manufacture of soap. It is not very desirable as a lighting fluid, as it does not give as clear light as whale oil or petroleum. For the fattening of hogs peanuts are exceedingly valuable, and have proved very satisfactory on account of their large content of fatty matter. Hogs are very fond of them.

THE VINE AS A FORAGE CROP—The haulm or vine, when carefully harvested, before it has been injured by frost, is an excellent food for cattle and sheep. Horses are exceedingly fond of it, but the amount of dirt which necessarily adheres to it is apt to produce a disagreeable cough. The red peanut makes better hay than the white, because it grows erect, and is, therefore, freer from dirt. Usually about one ton is saved per acre, though upon strong land, where the vines grow luxuriantly, two or more tons have been saved. Many practical farmers prefer this hay to clover hay. Like clover hay it must be handled carefully, or the leaves will fall off, leaving nothing but the stems, that are practically worthless. It produces a copious flow of rich, creamy milk when fed to milch cows. Ewes in lambing time can have no better food given them than well-cured peanut hay, because it increases the flow of milk and enriches its quality.

JAPAN CLOVER—BUSH CLOVER—KING GRASS—(*Lespedeza striata*)—(Grazing and Hay.)

There were numerous species of Lespedeza found in the South as far back as the time of the Spanish occupation of Louisiana. They were then observed and mentioned in Spanish records and regarded, at the time, as being good forage plants. The seeds of the Lespedeza striata were introduced into South Carolina about 1849 from Japan or China or probably from both, doubtless coming over in tea chests. Its existence in Japan was mentioned as early as 1784, by a German chemist, who saw it growing in that country. A few years after its first appearance in South Carolina it had spread as far as Macon, Ga. It appeared in Tennessee about 1870 and spread rapidly through many counties in the State, covering old fields, rooting out broom sedge and other grasses, and showing such a vigor of growth and tenacity of life as to arrest the attention of every observant farmer. It will grow with great luxuriance on the poorest soils, and will resist the severest droughts. Soils that are totally unfit for the growth of any other plant will produce Japan clover high enough to make good pasturage. On more fertile lands it will grow to the height of two feet or more. It is an annual and should be sown in the State of Tennessee during the month of March, but it is rarely necessary to sow it at all as, when it once becomes established in any spot, it soon spreads throughout the locality. It is an excellent plant for restoring fertility to old fields and many of these in the state have been reclaimed through its instrumentality. In many of the Southern States it is regarded as the

most valuable of all forage plants for the very reason that it will grow on the most sterile or exhausted soils. It is largely used for hay, especially when grown on calcareous soils, being said to have a high feeding value, though less than that of the cowpea and clover. It does not stand cold weather. The first frost will kill it, and occasionally it suffers from hot weather when grown upon thirsty, sandy soils. Its roots penetrate to a great depth in the soil and like all other leguminous plants it collects nitrogen from the atmosphere. It is much more highly esteemed in the extreme Southern States than it is in Tennessee.

Mr. H. B. McGehee, of Woodville, Miss., says: "My experience is that Lespedeza striata (Japan clover) is the most satisfactory and best all-around forage crop we have in Southwest Mississippi. It is the quickest grown, easiest handled and affords the most abundant yield of any hay crop we have. We prepare our lands and sow in October or March one-half bushel of seed to the acre. It yields from one and one-half tons to three tons per acre, reseeds itself, and the meadows may be left from two to three years without replowing. Often after preparing lands and sowing our fall oats we sow Lespedeza among the young growing oats some time in March, after all danger of a freeze is over, and thereby get two crops from the same piece of land during one year. Stock of all kinds eat this hay readily and fatten on it. It sells on a local market for from $12 to $15 per ton. Ours is a loamy, sandy soil, with a good deep subsoil."

Prof. S. M. Tracy, says of this plant: "Lespedeza is the standard clover plant of the South. It will grow on the poorest and dryest soils and, pound for pound, is the best hay I have ever used for fattening or for milch cows. Three years ago last October, our barn containing the hay we had stored for winter use was destroyed by fire. The last of October is late for making hay in Mississippi. On the day after the fire we put our mowing machines into a field of Lespedeza, which we had before thought hardly worth the cutting, and in two weeks we had stored a fresh supply of hay, mostly Lespedeza, but with a liberal mixture of asters, golden rod and plum bushes; but even this hay gave us better results in milk and butter than did equal weights of imported timothy."

Mr. Samuel McRamsey, of Warren county, Tennessee, who was in the dairy business for many years, says: "This clover made its appearance in this locality in 1870. It is fast covering the whole country. It supplies much grazing from the first of August until frost. It is short, but very hardy. Sheep are very fond of it, and cattle will eat it. It is killing out the broom sedge wherever it appears. It grows exceedingly well on red clay, and with a little care covers red hillsides that are much too common all over the state. If it will do this and destroy the broom sedge, it should be cultivated. It is not good for meadow and is only valuable for pasture."

Upon the farm of the writer in Montgomery county, Tennessee, the chief soil of which is a deep clayey loam belonging to the Lithostrotion bed of the subcarboniferous formation, Lespedeza appeared about 1880, and it quickly took possession of several wooded lots and also spread in some older fields that were not in cultivation. At first cattle were totally

SHEEP IN THE MEADOW.

indifferent to it and would not eat it, but gradually both cattle and sheep began to relish it. The advantage of this plant is its drought-resisting quality. On good soils it will remain green and continue to grow until the advent of frost. Broom sedge, in many places, especially in fence corners, has yielded to its conquering march. It is far less troublesome than broom sedge in every particular, and if it does no other good it will be regarded as a benefactor in its ability to destroy one of the most troublesome of all growths to meadows and pastures. During the period of dry weather it will turn brown upon thin soils, but the first rain will give it a new growth.

The best estimate of its value was made many years ago by Prof. E. M. Pendleton, of Georgia. He says: "I am willing to concede to it several things that do not apply to any other plant we have ever grown in this latitude.

"It has great powers of endurance, so far as the roots are concerned; but the branches and leaves will parch and die out under a burning sun very soon, especially where it grows sparsely. During a wet summer it luxuriates wherever propagated on poor hill-sides as well as on meadow lands. It loves, however, rainy seasons on thirsty lands and I fear will not prove to be all we desire in such localities. It however, reminds us of an anecdote of Mr. Dickson, when he was showing some gentlemen his farm during the prevalence of a severe drought. As they passed through a corn field in which some of the stalks were actually dying for lack of moisture, one of them called his attention to several in that condition. 'Yes,' said he: 'I perceive the fact, but it dies game.' And so of the Japan clover; it dies from severe drought, but rallies again as soon as the rain sets in.

"It is good pasturage for stock and I think would make good hay, if cut and cured. But I do not believe that our stock like it as well as the native grasses and I doubt whether it is as nutritious as the Bermuda. As cattle love variety, however, this may subserve a good purpose in that way. My opinion, however, is, from a not very close observation in the matter, that they would soon tire out on it exclusively.

"It furnishes a large supply of vegetable matter to the soil, and I believe will prove to be the best humus-making plant we have at the South, where so much is needed from our clean cotton culture. As it is said to be difficult to gather the seed in large quantities, I intend to plow up the surface where it has seeded, and rake up the grass and top soil, and sow this dirt over my oat and wheat fields, and especially on the poor places. My opinion is that a most luxuriant growth of this clover will follow, which can be turned under in the fall while green, and thus furnish not only humus but nitrogen to the soil.

"Another rare quality of this plant is indicated in the name I have given it—'King grass'—in the fact that it absolutely roots out and destroys every living plant in its wide-spread path. Not even old Bermuda, which has so long held undisputed sway over his circumscribed fields, can resist its encroaches. I have a bottom long since given up to the Bermuda. Recently I passed through it and found that the Lespedeza had almost completely throttled it, though like Mr. Dickson's corn it died

game, as here and there, peering above its enemy, could be seen an isolated sprig of Bermuda, which, as it cannot stand shade, will have to yield entirely before the close of another season. I have but little doubt that any pest, like coco or Bermuda, could be rooted out by this 'King grass' in a few years in any locality, and would recommend it to be sown on such fields, if for no other purpose. I intend to give it a fair trial myself on one or two similar localities."

The North Carolina Experiment Station has this to say:

"The ability to grow on land too poor to produce even broom sedge and to crowd out all other plants; its dying each winter and leaving its roots to fertilize the soil; and its possessing the nitrogen-fixing power peculiar to the pulse family of plants, place Japan clover at the head of renovating plants adapted to the climate of Southern States. It is unequalled as a restorer of worn fields, such as are generally turned out to grow up in pines."

SOY BEAN—COFFEE BEAN—SOJA BEAN—(*Glycine hispida.*)—(Forage, Ensilage and Pasture.)

This plant has recently been introduced into cultivation in the United States, though it has been known in China and Japan from a remote antiquity. It is one of the crops grown for human food in oriental countries. It yields a large amount of seed while the forage, both green and dry, is capable of sustaining and even fattening domestic animals. Experiments that have been tried in Tennessee in its culture have been fairly successful.

The soy bean is an annual, belongs to the leguminous family, and is grown for the same purposes as cowpeas and clover. As a soil renovator, as a hay and as ensilage it is nearly the equal in every respect of red clover.

There are many varieties of the soy bean. The early varieties are thought to be the best to cultivate for seed. The medium early green is the best for hay and this with the medium early black is best for soiling and for ensilage. Soy beans will grow upon almost any soil, but that which is supplied with potash, phosphoric acid and lime is said to give the best results. Good crops have been made on very thin soils in Kansas and South Carolina. It is a great drought-resister and will suffer less from continued dry weather than almost any ordinary field crop. It will grow in every latitude in which corn will mature. It is not so sensitive to cold as cowpeas or the ordinary garden bean. It will bear moisture well and a case is given by Mr. Robert C. Morris, of Illinois, where soy beans stood three weeks in water during the month of July without any permanent injury. For hay the beans should be sown at the rate of one bushel per acre upon land well prepared by thorough pulverization. The seed may be covered with a harrow. If planted mainly for seed it is best to plant in drills, say 30 inches apart, and cultivate in the same manner as corn. About five or six plants should be left for every foot in the row. It is best to stir the earth after every rain, but not to work the plants when they are wet either from rain or dew. The haulm of the soy bean is very rich in fat and muscle making constituents and should always be fed in

connection with fodder, corn or sorghum. It should be cut for hay when the plants are in late bloom or when a few of the pods begin to form. It is a hay very difficult to cure. much more so than red clover, and it is necessary after cutting to throw the plants into a windrow until they have wilted, then to put them up in cocks with small diameter so that the air can pass freely through them. Handling the hay injures it very much in causing the leaves to be broken off and lost. Probably the best plan for saving the hay is to stack it around a pole upon which long limbs have been left. These limbs admit the air, which causes the hay to cure

Soy Bean—Glycine hispida.
(U. S. Dept. Agric.)

much better, but as soy bean hay does not shed rain the stack should be capped with wheat straw or hay that will shed water.

When harvesting the crop for seed it may be cut with a scythe or mower and put up into small cocks until the pods become thoroughly dry. The threshing may then be done with a flail or with a threshing machine. The soy bean will yield upon good strong land from ten to fifteen tons of green forage per acre which will make from two to three tons of cured hay. At the North Carolina Station an experiment was made with the soy bean and cowpea upon the same character of soils, both grown under similar conditions. While the soy bean yielded 2 1-4 tons of cured hay per acre the cowpea yielded less than a ton.

The yield of the soy bean is very prolific, running from 25 to 40 bushels per acre and even 100 bushels have been reported under very favorable conditions. The soy bean like the cowpea may be sown upon stubble land after the wheat or oat crop is harvested. Two crops may thus be grown upon the same land and the land left in much better condition than it would be after the wheat or oat crop. In fact the bean crop is often worth twice as much as the wheat or oat crop, the seed selling for $1.00 to $2.00 per bushel, and the haulm is as valuable as an equal amount of red clover hay. All the analyses which have been made of the soy bean show that it compares well in useful qualities with other leguminous plants. The green haulm has nearly the same composition as red clover. It is richer in protein and fat than the cowpea.

In a comparison of many analyses made, it appears that the soy bean stands as well in digestibility as the clovers, cowpeas, alfalfa or any other legume whatever. As a soiling crop it is regarded as one of the most important. A succession of forage may be had from summer to autumn by sowing several varieties that mature at different times. As an ensilage crop it is surpassed by few. It is said that the silage keeps well and is readily eaten by stock, and the animals show good results in flesh and in the production of milk. When, as often happens, the bean is allowed to get too ripe for hay it may, with more profit, be used as silage. The hay, being coarse, is not eaten so voraciously as red clover hay or peanut hay, and that of many other leguminous plants.

Probably the best use which can be made of the soy bean in the South is for the fattening of hogs. When so used the labor and expense of harvesting is saved. It also forms an excellent pasturage for sheep. Prof. Georgeson, in his experience at the Kansas Station, has this to say in regard to its value for the production of pork:

"It was found that a lot of three pigs which was fed for 126 days on a ration consisting for the first eleven weeks of Kaffir corn meal alone, and the last seven weeks of Kaffir corn meal and shorts, gained a total of 191 pounds, while a similar lot fed two-thirds Kaffir corn meal and one-third soy bean meal gained 547 pounds in the same time. Another lot of three pigs which was fed on corn meal for the first eleven weeks of the experiment, and a mixture of two-thirds corn meal and one-third shorts for the last seven weeks of the experiment, made a total gain of 306 pounds in 126 days, while a similar lot of three pigs fed on two-thirds corn meal and one-third soy bean meal throughout the experiment gained 554 pounds in the same time. The largely increased gains in these pigs must be credited chiefly to the soy bean meal."

The soy bean may also be regarded as a valuable acquisition as an aid in the restoration of soils. It, like all other leguminous plants, adds nitrogen to the soil. For this purpose it is highly valued in Japan, and is one of the crops planted in rotation with the cereal crops. It is now generally believed that if planted in a corn field at the last plowing it will not only do much to enrich the field but it will also furnish almost as much food for live stock as the corn crop itself.

Prof. Jared G. Smith, Assistant Agrostologist of the United States Department of Agriculture, says that "the feeding value of the bean has

been found to be greater than that of any other known forage plant except the peanut." This is certainly very high commendation.

The farmers of Tennessee would do well to test the value of this bean practically on all the different varieties of soils. It would unquestionably be a valuable addition to the crops of the Cumberland table-land. It would be valuable in the sandy soils of West Tennessee but it would grow with the greatest luxuriance upon the valley lands of East Tennessee and upon the limestone soils of the Central Basin and the clayey lands of the Highland Rim.

Herd's Grass—Agrostis alba.

Timothy—Phleum pratense.

Tall Meadow Fescue—Festuca elatior.

Meadow Oat Grass—Arrhenatherum avenaceum.

Perennial Rye Grass—Lolium perenne.

FIVE IMPORTANT MEADOW GRASSES.

PART III.

MEADOWS AND THEIR MANAGEMENT.

Upon the proper selection of soils and situations for meadows will depend largely their permanency and their productiveness. The soil, its condition and situation are the most important elements of success. Above all things the soil must be fertile, or it should be made so by abundant fertilization. Poor soils will not produce rich grasses. Stable manure must be freely used on the soil if it is sterile in its character. Before such an application, however, the land must be deeply broken and underdrained if very dry or very wet. It is a well known fact that underdraining dries wet soils and gives the capacity to dry ones of retaining humidity. It stimulates plant growth earlier in the spring and keeps it up later in the fall, because it carries away the cold subterranean water, and by doing so the lower portion of the soil is warmed by diminishing evaporation. Droughts are never so disastrous upon well drained soils as upon undrained ones. When the soil is saturated with water, plant food becomes so much diluted that the roots must take in a larger quantity of fluid to nourish the plants, and the hay is greatly injured by this excess of moisture. Many soils that are intractable may be made mellow and well fitted for the growing of grasses by thorough draining. Drainage also makes all fertilizing matter have a better effect. The productiveness of the land when drained is largely increased, for the reason that the roots are enabled to range through a wider extent of soil in search of plant food By permitting the roots of the plants to penetrate deeper, drainage makes them more independent of the moisture of the surface soil, and so has the same effect as a rain fall.

Another great advantage which meadows receive from proper drainage is in the prevention of the formation in the soil of acids which are injurious to vegetation. Another is that it arrests or checks the heaving out of grasses in winter by freezing. Drainage also lessens the tendency to the formation of a hard crust on the surface after rains with supervening hot weather. Above all, drainage greatly facilitates that reaction which prepares the organic and mineral matter in the soil for plant food. All soils saturated with water are placed in a condition that stops the decay of vegetable matter incorporated with it. The mineral matters also require to be exposed to the air before they are put in a condition to be readily assimilated by plants.

Underdraining is but little practiced in the South and yet there is no work that is more essential to a good meadow. Drains should be made from forty to sixty feet apart and should be put at least three feet beneath the surface of the ground, with an outlet that will carry the water from

the field. Tiles make the best drains, though drainage is often affected by subterranean channels made of stone or even logs and brush. Low lands lying on creeks or rivers should have the drainage tiles placed in lines perpendicular to the general course of the stream. It must be understood that these drains shall have an inclination sufficiently great to carry off the water to the outlet. Nor should there be any low depressions in the drain where water will stand and stagnate.

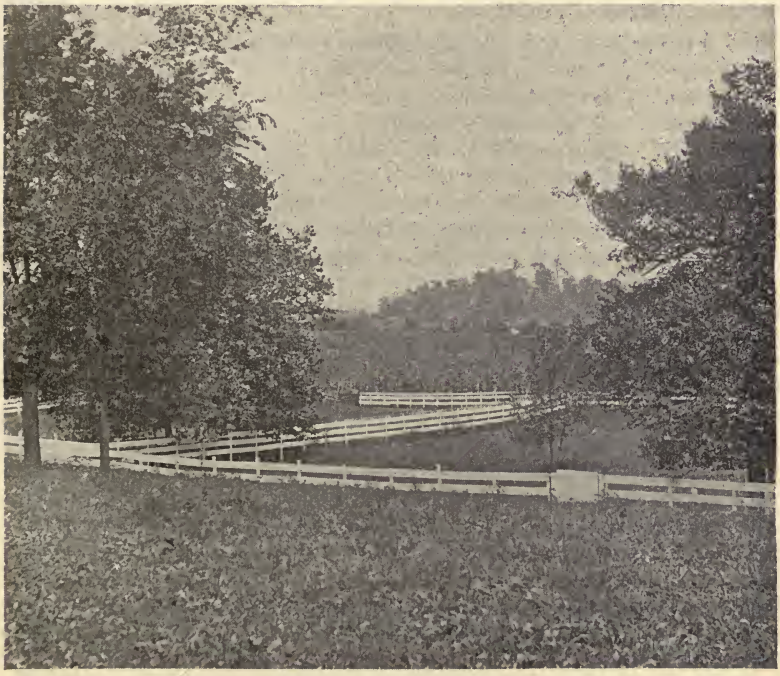
If the soil is neither very wet nor very dry in its character it will not be necessary to go to the expense of underdraining to secure good meadows. Select a low lying situation on a stream if possible. If this cannot be done take an upland valley in which the silt from the surrounding acclivities may be gently deposited from time to time upon the grass. The surrounding hills must not be so high nor so abrupt as to cause large quantities of silty material to be deposited at once. The deposit should be just sufficient to cover the base of the grass but not enough to cover the crowns. In the latter case much of the grass will perish; in the former the silty material will act as a fertilizer and as a mulch for the retention of moisture. Grass must have plenty of water but it must not be in excess. Nothing is more hurtful to a meadow than standing water, for after it retires many vacant spots will be seen. Argillaceous soils are often so compact as to prevent a healthy growth. In very loose soils the roots of grasses frequently suffer for want of moisture. In the selection of lands for either meadows or pastures the depth of the underlying rocky strata must be taken into consideration. If the underlying rocks come near the surface the grass will parch up during a dry season. The united depth of the soil and subsoil should be not less than four feet, and the subsoil should be a retentive clay capable of conserving moisture.

The soil best adapted to the growth of the leading meadow grasses is a calcareous loam with clay enough in its composition to give it a considerable degree of adhesiveness, and that will hold the grasses firmly, but not enough to give the soil so much compactness as to prevent it from being aerated and the roots from penetrating to a good depth. The soil must be neither too compact nor too porous. When too porous the manure applied to the meadow sinks too rapidly to a plane beneath the feeding depth of the roots. If too compact the roots are not able to go deep enough to secure the proper moisture; nor can the fertilizing material sink deep enough to be within the plane of moisture.

Some sandy soils make excellent meadows, especially when resting upon a clayey subsoil which retains moisture. Strong clay soils with a large admixture of sandy material in the form of chert, or of calcareous matter in the form of limestone gravel, make good meadows in proper situations. It is not unusual to find little strips of bottom lands lying on mountain streams in which the soil is largely composed of silty deposits with about an equal proportion of humus, sand and clay. Such meadows are very productive both of timothy and herd's grass hay. River bottom lands having black soils, which are liable to crack into deep fissures with the advent of hot weather, however fertile they may be, are unfit for meadows. Nor are those lands suitable for meadows that are liable to have a thick slimy deposit of vegetable matter left on them after over-

flows, for though they may be excellently well adapted for the growth of corn, the grasses will soon wither and die in such situations.

Good meadows are found in the latitude of Tennessee upon suitable soils, with every exposure and in almost every situation. The earliest meadows and those that produce the most nutritious hay have slightly southern exposures but not enough to absorb heat from the sun to such a degree as to wither the grasses at noon tide. A slight southern inclination, especially if facing a water course having a fringe of trees between the stream and meadow, is in all respects the best situation. Large quantities of hay may, as a general thing, be harvested from meadows having



Blue Grass Paddocks, Maury County, Tenn.

a northern exposure. The soils in such situations will retain moisture longer and moisture is indispensable to a heavy growth of grass. Though the growth will not be so quick or so early as upon southern exposures, it will be continued later in the fall months and in general the grass will be ranker and denser. Soils on northern exposures are also more fertile in a region having the same general character of soils. An eastern exposure will grow larger quantities of hay than a western one, because the growth of the grasses on the latter is checked to a greater extent by the heat of the afternoon sun. The earliest and most nutritious hay crops are harvested from meadows having a southern exposure; the largest yields

from those having a northern exposure. The meadows with eastern exposures will yield more hay upon similar soils than those having western exposures, but at the cost of a slightly inferior product. From the sun hay derives its sweetness and to the sun it is largely indebted for its rich stores of nutritive juices. Experience and analyses have demonstrated the fact that hay grown on well-prepared, well-drained and well-manured soils is more valuable than that grown on prairie or other unimproved lands in the larger content of its flesh-forming material; in the diminution of its indigestible matter; in the amount of its saccharine and other soluble constituents; in its succulence and fatty matters, and in its comparative freedom from dust, trash and noxious weeds. Every observing farmer knows that stock prefer the grasses grown on rich, well-prepared land to the grasses of the highway pastures or those grown on poor land. They prefer the grasses grown in the sun to the grasses grown in the shade, and the grasses grown in a dry season to those grown during the prevalence of rain and cloudy weather. The unerring instincts of domestic animals suggest many valuable ideas. Shade in a pasture, though desirable to a limited extent for protecting stock from the fervor of a mid-day sun, is highly detrimental to the nutritiousness of the grasses. Some shade should be provided in every pasture but never in a meadow, for all grasses grown in a meadow under shade are injured for hay making.

Lands intended for meadows should be prepared in the very best manner. Not only should the drainage be made perfect, if not so naturally, but the soils should be as well prepared as for the growing of the most highly cultivated crops. It should be put in the finest mechanical condition. Every trace of wild growth and of unimproved land should be effaced. Stumps should be extracted so that mowers and horse rakes may be used. All bushes, roots, stones, trash, brush and the turf of wild grasses and weeds, should be removed or destroyed. The cultivation of the land for a few years in crops requiring clean cultivation and high fertilization is probably the best preparation for a meadow. A crop of annual grass such as millet fits the land for a perennial meadow by destroying the weeds. New land with fertile soils, however, when put in good tilth, grows the meadow grasses to perfection. If old land is selected it should be deeply plowed and, if possible, sub-soiled; for deep tillage is essential to the luxuriant growth of the perennial grasses. Their roots constantly seek a lower level, and if the land is at first drained and afterwards fertilized year after year, and kept free from noxious weeds, the meadow will grow stronger and better with time.

There is a great difference in the duration of grasses and in their time of maturing. Some live but a short time; others are more permanent. Some mature in one year; others do not become firmly established for several years. Some are very nutritious; others are more showy than useful. Different species require different soils and in sowing a meadow some regard must be had for these differences. A much greater amount of hay may be made by sowing several species that ripen together. This arises from the fact that some grasses will grow in one situation but not in another and by the further fact that a plant of one species is a greater

enemy to another plant of the same species than to a plant of a different species. Among the grasses that may be most profitably sown for meadows in Tennessee are timothy, herd's grass, perennial rye grass, meadow oat grass, and tall fescue grass, with a slight sprinkling of clover. In sowing a meadow each kind of seed should be sown separately. If the seeds are mixed together the weight of some will prevent them from being uniformly distributed with the lighter seeds. He who desires a good meadow should not spare the seed. A wise plan is to sow nearly as much of each kind of seed upon the meadow as is required when only one kind is sown.

The best time for sowing meadows in Tennessee is the last of September or the first of October. After the seeds are sown they should be covered with a roller or a light brush and all stock kept out. Farmers more often than otherwise sow grass seed in the fall of the year with wheat. This is poor economy. A meadow should be sown for its own sake. In trying to save the cost of preparing the land a second time there results in a majority of instances, the total loss of the grass seed. At any rate in sowing grass seed with wheat, rye or barley a whole year and a half must elapse before any returns can be realized from the meadow. Another objection to this method is the temptation to pasture the stubble lands during the heated term and so destroy or impair the vitality of the grasses. If the soil has been properly prepared and a sufficient amount of good grass seed sown alone in the early fall one may expect with the greatest confidence a good crop of hay the succeeding summer. Oftentimes the heaviest crop of hay is the first one. This arises from the fact that close mowing the first year frequently kills a portion of the meadow grasses, leaving bare spots. Grasshoppers often eat the crowns of the fresh grass in the fall of the year, and so thin it out. Grazing the aftermath, which many farmers practice, does much damage to the meadow, to say nothing of the injurious effects resulting from the heavy tread of cattle, especially when the ground is soft and wet. Tramped in this condition the soil becomes, after exposure to the sun, little better than a sun dried brick.

It frequently happens that a meadow becomes "hide-bound;" that is to say, the soil and subsoil run together and become very compact either from tramping of stock or from standing water. When this is the case the grass will show a diminished vitality by turning yellow. Under these conditions it will rarely grow tall enough to be mowed. The best remedy for this "hide-bound" condition is to take a very narrow subsoil plow with a coulter attached and run it at intervals of two feet through the meadow and as deep as possible. This will roughen some places but by running a fine toothed harrow over it it may be made sufficiently level for the mower. The best time for this subsoiling is early in the spring, as soon as the ground becomes dry enough to plow. Old meadows may be made productive by pursuing this plan and top-dressing with manure directly afterwards. This same treatment should be given to pastures after they have ceased to be productive.

MANURING OF MEADOWS—The farmers of Tennessee rarely cut the aftermath. Sometimes it grows high enough during a wet sum-

mer to mow but they usually depasture it. In fact meadows are put to their severest trials after they are mowed in June or July in consequence of the dry, hot weather which supervenes. It is best not to apply stable manure during the continuance of hot, dry weather for such manure has the effect of making the meadow still dryer and of attracting a number of insects that cover and feed upon the small green blades. The best treatment after mowing is to top-dress with about 100 pounds per acre of the nitrate of soda. This preserves the verdure of the grass. In two or three weeks an application of an equal quantity of bone meal or the superphosphate of lime should be added. Some ammonia in the form of sulphate will have a beneficial effect. Where there is clover gypsum may always be applied with good results. After the fall rains begin stable manure should be applied freely. It is the best of all manures, on our soils, for grass lands.

Baron Lawes writing in 1858 thought that "a dressing of dung once in five years with two hundred weight of the nitrate of soda each year for the other four years" was the very best manure that can be used. Dr. Voelcker was of the opinion that good barnyard manure is "the most efficacious and economical manure both for seeds (of clover) and permanent pasture." The effect of bone dust on meadow lands is not thought to be as great as on pasture lands. "Bone meal is usually wasted when applied on cold clay soil." Dr. Voelcker also says: "unfortunately the application of artificial manures to permanent pastures is often disappointing in an economical point of view. As a rule, no artificial manure gives so favorable a return as good farmyard manure, and I cannot help thinking that it would be more profitable for a farmer to apply the larger portion of his yard manure rather to his pasture land than to the arable land; for there is no difficulty in growing roots and cereal crops economically with artificial manures."

A writer in the Journal of the Royal Agricultural Society in 1869 says: "After much experience, I think manuring grass lands is one of the worst subjects to treat. I have seen bones applied and produce no good whatever; and on the other hand, I have seen them used with immense advantage. I have seen guano produce a splendid crop, while the year following the crop has been worse than before guano was applied. It is impossible to give any definite rules without knowing the kind of land to be manured, and other attendant circumstances. Still, money judiciously laid out in the improvement of grass land brings in a more certain return than when expended in the growth of wheat."

In the manuring of clover fields gypsum will greatly increase the forage but not the seed. Superphosphate of lime, nitrate of potash and stable manure are much better for increasing the yield of seed and should be applied to the clover after the first crop has been cut off for hay or depastured by stock. All manures will, as a general proposition, so increase the strength and vitality of the better grasses as to diminish the weeds. This may be seen by the application of stable manure to a broom sedge field: the broom sedge disappears and the better grasses assert their sway.

In some famous experiments conducted by Lawes at Rothamsted in

England it was clearly shown that superphosphate of lime was favorable to the growth of the true grasses, but not to the leguminous plants. Ammoniacal salts were of but little benefit to the grass when applied to the meadow. Nitrate of soda increased the grasses and kept them green for a longer period, more leaves and fewer stems being the result of the application. A mixture of superphosphate of lime and ammonia had precisely the same effect as the superphosphate alone. Mineral manures alone increased the leguminous plants and diminished the grasses. Mineral manures and ammonia increased the grasses but not the leguminous plants. Mineral manures and nitrate of soda had the same effect as mineral manures and ammonia. Gypsum produced its greatest effect upon leguminous plants but its effect on the grasses was slight. The most potent application was farmyard manure, which increased the hay grasses and the leguminous plants and encouraged the growth of many good grasses and some bad ones, as well as some noxious weeds. It was by far the best application, though attended with some undesirable results. The general conclusion reached was that drainage is highly important. The application of mineral manures, such as potash, lime, gypsum and marl, is followed by good results, though attended with too much expense. The use of bones was discouraged. "The grasses proper appear to be the most strikingly independent of any artificial supply of carbon. The hay crop is more exhaustive of potash than wheat or barley. A predominance of mineral elements in the fertilizers increased the proportion of the culms of grasses, while a predominance of ammoniacal salts increased the proportion of leaves. Those manures which much increased the produce of hay, at the same time very much increased the proportion of graminaceous plants. The total miscellaneous herbage (chiefly weeds) were the most numerous in kind and nearly in the greatest proportion on the unmanured land, viz: 16 per cent., while on the manured plat they decreased to 2 per cent."

In summing up the results of these painstaking and suggestive experiments, Baron Lawes says:

"We learn from these results that good pasture grasses can never thrive upon a poor soil; and if a soil does not contain in itself the elements of fertility they must be added from external sources. I may add that if the pasture of a rich soil deteriorates from bad treatment the good grasses do not die out, but only retire from the contest to wait for better times. Under invigorating treatment it will be found that the good grasses soon reassert their supremacy.

"The general result, comparing the product by the different manures in one and the same season, seems to be that the more the produce is graminaceous the more it goes to flower and seed, and the more it is ripened the higher will be the percentage of dry substance in the hay. Under the same circumstances, the higher will be the percentage of woody fiber and the lower will be that of the nitrogenous compounds and of the mineral matter. On the other hand, in a large proportion of the non-graminaceous herbage the reverse of these things is true."

TROUBLESOME PLANTS IN MEADOWS—The proper care of meadows after they have been mowed must not stop with the application of manures. There are many noxious plants and weeds that spring up

when the grasses are enfeebled by mowing, especially if the mowing is followed by dry weather. The most pestiferous of these is broom sedge (Andropogon Virginicus). If left alone it will grow to the height of three feet after the hay has been cut. If permitted to seed, the meadow will show a largely increased number of these plants the following season. Each tussock of this vile grass before it goes to seed should be cut up with a sharp sprouting hoe. If permitted to grow the meadow will be destroyed in a very few years.

Another troublesome plant is the fleabane (Erigeron Philadelphicus) known as "white top" in Tennessee. This will thicken on suitable soils very rapidly. There is no remedy for this except running the mower over the meadow before the seeds ripen.

The trumpet flower (Tecoma radicans) infests meadows on rich bottom lands and it is especially troublesome on strong limestone soils. When cut off by the mower it forms hard knots which will arrest the action of the sickle. This vine should be dug up "root and branch." While white clover and blue grass are both great enemies to the meadow grasses, their presence will have the effect of rapidly converting a meadow into a pasture.

THE HAY HARVEST—The first grass that ripens for the harvest in Tennessee is the Italian rye grass. There is only a small quantity of land, however, laid down in this early meadow grass. The red clover crop demands the earliest attention from a majority of farmers. This is cut for hay from the time it blooms in the middle of May until the middle of June. Varieties of soils exert a perceptible influence upon the period of inflorescence. On strong limy soils clover is usually ready for the mower two or three weeks earlier than when grown on cold or heavy clay soils. Timothy and herd's grass follow soon afterwards and the harvesting of these usually continues until the middle of July. Millet grown on strong soils is harvested in about sixty days after it is sown. It is not possible to define the precise stage in which grasses should be cut, for this depends upon the uses to be made of the hay and upon the character of stock to be fed. If the object is to produce the greatest quantity of milk, grass should be cut before coming into blossom, for at that stage it contains the greatest amount of succulence and will produce the largest flow of milk. If the richness of the milk is desired rather than quantity, grass should be harvested while in blossom. For work horses, mules and oxen and for fattening cattle the harvesting should be deferred until the seed is in the milky state and the blades of the grass are still green, or at least but slightly spotted. For "roughness" or "distending" forage the hay should be cut when only a portion of the flowers have fallen. At this stage it is filled with starch, gum and sugar. After the seeds become ripe these ingredients are changed into woody and indigestible fibre. The seeds themselves, indeed, after ripening contain a large amount of very nutritious matter but the value of the hay grasses with ripened seed is greatly lessened and the juicy stalks and blades will be worth no more than wheat straw. With wheat, corn, barley, rye and oats the reverse is true, as the seeds are worth much more than the forage from such crops would be if cut when in flower.

Prof. Armsby comes to the following conclusions as to the best time

for cutting hay: "Young plants while rapidly growing contain relatively more protein and less fibre than more mature ones; consequently early cut fodder must be of better quality than that cut late. It is more digestible.

"Three elements enter into the problem of selecting the best time for cutting, viz.: the quality of the fodder, its quantity, and the amount of labor expended upon it. While any grass is ripening a large part of the protein and starch passes from the leaves and stem to the seeds, which are so small that they are seldom masticated or digested. Moreover, they are easily lost in curing. The hay made from fully ripe grass is essentially straw.

"If only one crop is to be obtained, probably the best time for cutting is usually when the plants are just beginning to blossom. At this time a larger crop is obtained than if cut earlier, while the digestibility is not seriously impaired."

If cut early there is a great advantage to the second crop, as shown by an experiment at Hohenheim:

	PERCENTAGE OF PROTEIN	TOTAL POUNDS OF PROTEIN	TOTAL DRY MATTER, POUNDS
One cut.....	16.3	434	2,662
Two cuts.....	24.4	668	3,274

One cut—Percentage of protein, 16.3; total pounds of protein, 434; total pounds dry matter, 2,662.

Two cuts—Percentage of protein, 24.4; total pounds of protein, 668; total pounds dry matter, 3,274.

"The legumes are characterized by the large proportion of protein contained in the plant as a whole, and in the seeds. As fodders, when properly cut and cured, they are very rich, but have the disadvantage of being rather bulky, and of being easily subject to deterioration by mechanical losses. As a general rule clover is richer in nitrogenous matters than grass. Compared with meadow hay, which is made from the true grasses, its protein is about equally digestible, its crude fibre decidedly less digestible."

Full instructions have been given in Parts I and II as to the proper method of curing the different varieties of hay and forage plants. With the improved harvesting machinery and implements now in general use consisting of the mower, tedder, horse-rake, six-tined pitchfork and hay wagon bodies, the expense attendant upon saving a crop of hay is not one-fifth as great as it was when farmers had to rely upon the scythe, wooden pitch-forks and hand-rake. This great reduction in the cost of harvesting the hay crop has increased the product many times throughout the Southern States.

In 1880 the production of hay in these states was 1,412,358 tons; in 1898, 4,386,669 tons. The yield has increased from .82 of a ton per acre in 1880 to 1.45 tons per acre in 1898. The increase in the State of Tennessee has been still more rapid as may be seen by the following table from the census report;

HAY PRODUCED IN TENNESSEE.

1870.....116,582 tons
1880.....186,698 tons
1890.....630,417 tons

The extraordinary increase during the past ten years in the acreage sown in cowpeas is one of the most favorable signs in southern agriculture. It will be one of the marked changes that will appear in the report of the twelfth census. Throughout the State of Tennessee this increase has been within the present decade fully 500 per cent. The haulm of the pea is now largely employed for the feeding of cattle and sheep during the winter months. Those varieties of peas that produce seed not subject to early decay from humidity are left ungathered, and they form no in-

PASTURE, CAMDEN, BENTON COUNTY, TENN.

considerable item in reducing the expense of fattening swine and of carrying stock through the stress of winter. This change was one greatly needed, for, in addition to furnishing nutritious food for stock, the pea crop is a good fertilizer. Nor is the pea crop subject to the disastrous failures of the clover crop, though yielding a forage and a fruitage equally as valuable to the farmers of the South.

PASTURES—Much land that is totally unfit for meadows may profitably be laid down in pasture. Such lands as are too rough for cultivation often make the very best pastures. The utilization of the rough limestone lands of Southwestern Virginia for making pastures has made

them as valuable as the best arable lands of that state. On these pasture lands hog-back ridges are often seen, making it impossible to grow any tillage crop, and yet these lands make the finest blue grass pastures in the South, not excepting those in Central Kentucky, and are worth from fifty to a hundred dollars per acre for the raising of cattle. Likewise in some of the rough lands of East Tennessee may be seen strong growing, nutritious grasses upon lands that are worthless for any other purpose except for pasture.

In selecting grasses for the pasture an opposite course must be pursued from that pursued for a meadow. In the latter only such grasses should be sown as mature about the same time. In a pasture, on the other hand, the grasses selected should form a succession of green forage from early in the spring until late in the fall. Some pasture grasses also die out after the first year, while others do not reach their greatest value for several years after being sown. In selecting pasture grasses regard must be had to their turf-making qualities. A grass may be eminently adapted to the making of hay and yet be totally unfit for the pasture. Our best meadow grass, timothy, will not survive as a pasture grass because it cannot bear the close cropping and heavy tread of cattle.

Some grasses are relished by one kind of stock and not by another. The author of British grasses, M. Pleues, put the case happily thus: "Sheep have strong likes and dislikes. They will hasten to a kind of grass which is a favorite with them, tramping down all the other grasses as unfit to taste. Horses, again, have their preference and cows theirs, and we have even seen swine exercise considerable cunning to secure a feed of a favorite grass. So the agriculturist has as much to consider as a master of ceremonies; he must consult the capabilities of situation, the qualities of his provision, and the various tastes of his company."

In the selection of a situation for pasture it is highly important that the soil be naturally moist in its character. Pastures suffer more in the South from dry than from cold weather or heavy grazing. When they occupy a thirsty soil they may furnish good grazing during the wet spring months, but the grasses parch to a crisp when the hot weather of July and August comes on. Early pastures do well on southern slopes, but low level bottom lands or north hillsides having rich soils can only be depended upon for good pasturage during the heat and dryness of summer.

The best grasses for pasture lands in Tennessee are the following:

Blue grass—(*Poa pratensis.*)
June grass—(*Poa compressa.*)
Orchard grass—(*Dactylis glomerata.*)
Meadow fescue—(*Festuca pratensis.*)
Hard fescue—(*Festuca duriuscula.*)
Herd's grass—(*Agrostis alba.*)
Bermuda grass—(*Cynodon dactylon.*)
Meadow foxtail—(*Alopecurus pratensis.*)
Sheep's fescue—(*Festuca ovina.*)
White clover—(*Trifolium repens.*)
Red clover—(*Trifolium pratense.*)

Four or five of these grasses, the names of which are given above, should be sown together in the fall of the year on land intended for a per-

manent pasture. The larger the number of grasses sown on a pasture the longer the pasture will last and the fewer the vacant spots, especially if it is on land capable of retaining moisture. In Holland, one of the finest grass countries in the world, the meadows are often depastured during one year and cut for hay the following year, and so on alternately. In that country it requires about two acres of pasture land to fatten a large ox. In the bottoms of the greatest fertility along the Rhine an extent of surface equal to 1800 square yards is calculated to keep a cow.

The farmers of Tennessee should have more permanent pastures than they have at present.

GRASSES SUITABLE FOR LAWNS—Many people with suburban places and farmers wishing to beautify and adorn their homes have asked for a mixture of grasses suitable for lawns and woodland pastures. To gratify this desire the subjoined mixtures with the amount of seed to be sown per acre are recommended. A few of these grasses are unfit for general cultivation in the State of Tennessee, and yet as a mixture in lawns they may be sown with almost a certainty of securing a good stand. If it is intended to mow the lawn or yard frequently the following mixture may be used:

Kentucky blue grass	10 lbs.
Hard fescue	5 lbs.
Wood meadow grass	5 lbs.
Sheep fescue	2 lbs.
Meadow fescue	4 lbs.
Sweet scented vernal grass	2 lbs.
Red top	15 lbs.
Yellow oat grass	4 lbs.
Crested dog's tail	6 lbs.
Orchard grass	5 lbs.
Meadow foxtail	5 lbs.
	63 lbs.

Flint recommends as a mixture for permanent lawns and pastures lying within the vicinity of dwellings or public highways the following, to which I have added one or two other grasses:

Meadow foxtail	3 lbs.
Sweet scented vernal	2 lbs.
Orchard grass	3 lbs.
Hard fescue	2 lbs.
Sheep's fescue	2 lbs.
Meadow fescue	2 lbs.
Italian rye grass	3 lbs.
Perennial rye grass	4 lbs.
Timothy	3 lbs.
Red top	3 lbs.
English blue grass	5 lbs.
Rough-stalked meadow	3 lbs.
Yellow oat grass	1 lb.
Red clover	2 lbs.
Perennial red clover	2 lbs.
White clover	4 lbs.
Fowl meadow grass	3 lbs.
Kentucky blue grass	14 lbs.
	61 lbs.

In the selection of these grasses for lawns the idea of beauty should be preserved as well as the nutritiousness of the grasses. Some grasses will grow and maintain their verdure throughout the dry season, giving a freshness to the lawn, and yet will be of but small value for the grazing of stock.

The following mixture is also suggested, which will probably do better on argillaceous soils thinly shaded than the first mixture named:

Tall oat grass	1⅓ lbs.
Tall fescue	1¼ lbs.
Meadow fescue	1¼ lbs.
Meadow foxtail	1 lb.
Orchard grass	2 lbs.
Hard fescue	1 lb.
Sheep's fescue	2 lbs.
Quaking grass	½ lb.
Comb grass	½ lb.
Sweet scented vernal	1 lb.
Timothy	½ lb.
Kentucky blue grass	14 lbs.
Red top	10 lbs.
Tufted hair grass	¼ lb.
Red clover	5 lbs.
White clover	3 lbs.
Fowl meadow	2 lbs.
	44⅓ lbs.

For orchards and shady places the following mixture of grasses and the quantity of seed per acre will be found suitable:

Orchard grass	20 lbs.
Hard fescue	2 lbs.
Tall fescue	2 lbs.
Italian rye grass	3 lbs.
Perennial rye grass	3 lbs.
Timothy	6 lbs.
Red top	10 lbs.
Wood meadow grass	4 lbs.
Rough-stalked meadow grass	2 lbs.
English blue grass	4 lbs.
Perennial red clover	3 lbs.
White clover	4 lbs.
	63 lbs.

For rocky or gravelly lands the following mixture is recommended:

Red top	2 lbs.
Tall oat	2 lbs.
Crested dog's tail	3 lbs.
Orchard grass	3 lbs.
Red fescue	4 lbs.
Meadow soft grass	2 lbs.
Perennial rye grass	6 lbs.
Timothy	6 lbs.
Wood meadow grass	3 lbs.
English blue grass	2 lbs.
Rough-stalked meadow grass	2 lbs.
Black medic	3 lbs.
White clover	8 lbs.
	46 lbs.

Lands liable to be overflowed with fresh water will do best if sown with the following mixture:

Fiorin	4 lbs.
English Bent	3 lbs.
Tall fescue	5 lbs.
Slender fescue	2 lbs.
Manna grass	5 lbs.
Reed canary grass	3 lbs.
Timothy	4 lbs.
Red top	3 lbs.
Rough-stalked meadow grass	4 lbs.
Fowl meadow grass	6 lbs.
White clover	3 lbs.
	42 lbs.

Prof. Beal, of the University of Michigan, recommends the sowing of two bushels of Kentucky blue grass and two bushels of small bent

View on Lawn, University of Tennessee.

grass, known as Rhode Island bent, brown bent, or creeping bent, or red top, to the acre for lawns. He thinks a few ounces of white clover seed might be added, but it is by no means important. The bent grasses, so-called, correspond with our herd's grass. He, as well as Prof. Scribner, objects to the sowing of orchard grass in a lawn. My observation and experience convince me that when orchard grass is sown at the rate of three or four bushels of seed per acre in a woodland pasture where most of the trees are oak it does better than the finer grasses, because it is a

stronger grower and is able to withstand the damaging effects of the heavy oak leaves. Being sown thickly it covers the ground completely and will not appear in a tussocky form for two or three years. My opinion is that orchard grass in such situations is to be preferred to any other. Lawns should be sown with about double the number of seed that is used for a pasture. The object is to have the ground covered. The seed should be sown without any "nurse crop."

In the preparation of lands for a lawn the greatest care must be taken to have the soil enriched and raked until it is as fine as garden mold. No clods or stumps or rocks should be left on the surface. After the seed is sown the lawn should be rolled and as far as possible all the little inequalities in the surface filled. Frequent mowing of lawns is the only method of preserving their attractiveness and beauty. The grass should never be permitted to seed.

Bermuda grass makes a beautiful lawn, but is apt to turn brown the latter part of the summer. Where there is a sufficient supply of water to keep the ground moist by sprinkling it forms a beautiful covering for the yards and lawns of the Southern States.

The question in the South is not so much what will make the most attractive lawns, but what grasses will best resist the heat of the long summers. Any grass, however, will look better than the bare earth, and every effort should be made to have the wooded lawns and the shady yards covered with verdure.

THE HIGHWAY PASTURES OF TENNESSEE AND THEIR NUTRITIOUS HERBAGE.

Probably no state in the Union, lying east of the Mississippi river, has such a wealth of highway pastures as Tennessee. These pastures are common in every division of the state. In East Tennessee the "balds" of the Unaka mountains, at an elevation of 5000 feet above the sea, are well watered and are supplied with rich soils upon which several grasses and leguminous plants grow luxuriantly and furnish good grazing for stock several months in the year. The areas of these natural mountain pastures are limited, but in their capacity for carrying stock they are not surpassed by an equal area of the best blue grass pastures of Kentucky. The frequent rains in the mountain district during the growing season with the fertility of the black granitic prairie soils induce a rapid growth of the wild grasses so that there is a continuous succession of nutritious herbage from April until October. During this period all kinds of stock-horses, cattle, sheep and swine, feed on these grasses unvexed by the flies that so often torment stock on valley plains. In many of the open woods of East Tennessee lying at the base of the mountains are found growing in spring and summer wild grasses and other plants of great value for grazing purposes.

But the most extensive highway pastures in the State are found on the Cumberland table-land at an elevation of 2000 feet above the sea. Broad, grassy stretches of open woods, and acclivities green with verdant turf, characterize the top of this table-land everywhere except in those places where the abundant underbrush has choked out the grass. In trav-

eling over the grassy undulations of the top of this natural division of the State in the spring of the year one is able to realize the description of the pastoral countries of the Orient "with cattle upon a thousand hills." Hundreds of streams with thousands of contributing rivulets furnish the purest of water, while the park-like landscapes with their beautiful arboreal growth of pine, oak, chestnut, gum and other trees supply grateful shade to the stock during the heat of the day. The sun shines upon those airy heights with a splendor unknown elsewhere in the State, and breezes sweep over the mountain during the fervor of the day, tempering the air and making one of the most delightful summer climates to be found in America. The purity and elasticity of the air make this whole region one of greatest healthfulness to man and beast. When passing through the

Panicum latifolium.

silent forests of the mountain the earth covered with untrodden grasses and emblazoned with myriads of wild flowers—"born to blush unseen"—it requires no great stretch of the imagination to suppose the landscape to be now as it was before the discovery of America by Columbus, when it existed in all its primeval beauty. There are no natural pasture lands in America that surpass the pastures of the Cumberland table-land when the healthfulness of the region, its freedom from blizzards, its ample supplies of shade and water and its beautiful situation are taken into consideration. The grasses spring up in April, grow until late in November, and oftentimes supply some grazing throughout the winter months. The area of this division of the state is over 3,200,000 acres of which not less than 2,300,000 acres are given up to natural pastures.

Lying west of the Cumberland table-land is the region about 900 feet above the sea known as the Highland Rim that encircles the great central limestone basin of the State. This Highland Rim comprises nearly 6,000,-

000 acres, one-third of which area is devoted to highway pastures. West of Nashville in the counties of Cheatham, Dickson, Hickman, Humphreys, Lewis, Wayne, Perry, Houston and Stewart, not over one-fifth of the land is in cultivation. Out of the 2,699,520 acres embraced in these counties only 481,456 were returned by the census of 1890 as improved lands. The remainder was in woodlands and natural pastures.

The highway pastures in West Tennessee are not so extensive as they are in the other two grand divisions of the State. These pastures are confined mainly to the Mississippi bottoms where a dense growth of cane keeps a large number of cattle throughout the year.

The wild grasses and legumes that are found in the highway pastures of Tennessee are numerous. The most valuable ones with their habitat are the following:

Barnyard Grass—Panicum crus-galli.

GRASSES IN HIGHWAY PASTURES.

Andropogons (beard grasses).—There are several species of these grasses. Among others may be named: Andropogon scoparius, Andropogon provincialis, Andropogon argyraeus, Andropogon macrourus, and Andropogon Virginicus.

Andropogon scoparius (mountain sedge) has long been known in the mountains of East Tennessee. By some it has been confounded with the Andropogon Virginicus. It is a good pasture grass when young and tender, but when it shoots up its culms it becomes hard and indigestible. It is not general over the State.

Andropogon provincialis, var. furcatus, Tennesseensis and others, (big blue stem) though growing taller and stouter than the Andropogon Virginicus, does not so readily take possession of old fields and meadows but prefers open woods and retired nooks and dry soils. The stems are

Drive Up The Hill, University of Tennessee.

very leafy. It supplies good grazing and is not so troublesome as the Andropogon Virginicus. When cut young it makes a very good hay. It is not worthy of cultivation but it answers a very useful purpose in the highway pastures in every part of the State. Samuel M. Ramsey, of Warren county, tried it for butter-making as against some of the domesticated grasses and claimed that it made butter of better flavor and quality, and more of it than herd's grass or blue grass.

Andropogon argyraeus (silver beard grass.) This is a native grass, found in East Tennessee among the mountains and on the borders of woods. It is rarer than either of the other species mentioned and probably is of no importance as a grazing grass. It is easily recognized by its dense silky and silvery white flowers in September.

Andropogon macrourus (cluster flowered beard grass). This grows on wet or swampy lands and very much resembles the next to be men-

Setaria viridis.

tioned. It is found at intervals all over the State. It is not so valuable for grazing as the broom sedge, though cattle will eat it in early spring.

Andropogon Virginicus (broom sedge). This grass is very palatable to stock when young and tender but totally worthless when its culms begin to shoot up. It is the best known grass in the State and grows in almost every locality. It is a great enemy to meadows and will soon take possession of them if not resisted vigorously. It is the grass that takes possession of all "old fields" in every part of the State. While furnishing good grazing in early spring for all classes of stock, during the summer after its stems shoot up the grass becomes so tough and indigestible that no stock will touch it. After frost it turns brown and is an eyesore to every landscape where it makes its appearance. Its only value consists in its capacity to furnish early grazing and its agency in the stopping of

gullies. By many it is regarded as the flag of sterility, but this is not true as it will grow more vigorously upon rich than on depleted soils. It is one of the leading grasses in open woods and highway pastures.

Panicum latifolium (broad leaved panic grass). This grass is frequent in the open woods of the Highland Rim. It grows to the height of one to two feet but it grows intermixed with other plants and does not seek companionship of its own kind. It is a good pasture grass, bears close cropping and grows rapidly and constantly.

Panicum clandestinum (hidden panic grass). Much like the last but coming in a month later. It grows in a solitary manner and is found along the banks of the Cumberland river and in bottom lands in East and West Tennessee.

Panicum crus-galli (barnyard grass). Stock will eat this as greedily as any other species of grass whatever. It is a coarse grass and its favor-

Paspalum distichum.

ite habitat is in drained ponds and marshes. It will grow with great vigor in ditches and low bottom lands and furnishes good grazing for stock.

Setaria (foxtail grass). There are several wild species of this grass that furnish some grazing when young and tender. Setaria viridis (green foxtail) is common to all stubble lands and consorts with crab grass (Panicum sanguinale.) Setaria verticillata, or bristly foxtail, is probably the best wild species for grazing. The millet grasses belong to this genus. They have been treated in Part I.

Paspalum. Among the wild indigenous grasses there are several species of this genus that are held in high repute as grazing grasses. Paspalum distichum. Paspalum digitaria and Paspalum angustifolium

are all numbered among the grasses found in cultivated fields and frequently in the highway pastures of the "barrens" and indeed in nearly every natural division of the state.

Elymus Virginicus (lyme grass) grows abundantly in Middle Tennessee on strong, limy soils but it forms no turf. It is found near woods and thickets, and stock is fond of it. There are three or four species belonging to the genus Elymus but only one other is eaten by stock and that is Elymus Canadensis, or Terrell grass. This is usually found on the banks of streams.

Danthonia compressa (mountain oat grass). This is one of the principal grasses on the "balds" of the mountains in East Tennessee. They will bear the closest grazing and are highly esteemed in the mountain region.

Danthonia spicata is another species of this grass found growing on the Harpeth hills of Middle Tennessee and over parts of West Tennessee. It is one of the grasses furnishing grazing on the highway pastures of the Highland Rim.

Mountain Oat Grass—Danthonia compressa.

ARUNDINARIA (cane). There are two species of this grass found in Tennessee, viz: Arundinaria gigantea and Arundinaria tecta. It is possible that these two are really varieties of the same species. In the first settlement of the State cane was the principal dependence for stock grazing in the summer and in many sections the whole face of the country was covered with it. The shoots of the young cane are both succulent and nutritious. It grows best on the richest land, but if the poorest soil is once set with it, it acts as a fertilizer. This is to be attributed to its wonderful net-work of roots, the immense foliage it deposits on the soil, and to its dense shade. It is a very difficult matter to break up cane land,

but once broken, the roots quickly rot and add to the fertility of the soil. The roots run to a surprising length and depth, and serve as pumps to raise dormant fertilizing material from below the reach of any plow.

The farmers living near the Mississippi bottoms find the immense cane-brakes in that region exceedingly useful. They are in the habit of driving their stock to them, and the most luxuriant pasturage is obtained, both summer and winter. Cane will not grow in standing water, as the presence of water destroys its roots. Therefore, it is only found on land elevated above the swamps.

FESTUCA—The genus Festuca contains many species that are highly valued for grazing purposes. Several of the fescue grasses have been already treated in Part I. The sheep fescue is one of the principal grasses

Cane—Arundinaria tecta.

found growing on the mountain soils of East Tennessee and in other portions of the State where there are light, thin and siliceous soils. The red fescue (Festuca rubra glaucescens) called also Tennessee fescue, is an admirable native grass. It makes a good pasture where many other grasses would fail. Nodding fescue (Festuca nutans) is most frequently seen about thickets. Sheep will eat it but do not relish it so much as they do the sheep fescue. Short's fescue (Festuca Shortii) is probably a variety of the same grass.

POA—Many species of this genus have already been treated in full in Part I. Several of them grow with great luxuriance among the high mountains of East Tennessee. The writer has seen the densest turfs of low spear grass (Poa annúa), leafy meadow grass (Poa alsodes) and short meadow grass (Poa brevifolia) growing in the elevated valleys of Johnson county and on the crests of Iron and Roane mountains. Kentucky blue grass also grows well in the same situations and gives richness to the mountain pastures.

Other species of this family are common along the river banks of East, Middle and West Tennessee. The genus Poa is probably the most valuable of all genera of grasses for grazing purposes. Scribner mentions

Tennessee Fescue—Festuca rubra glaucescens.

fourteen species as growing in Tennessee. Every species is more or less valuable.

EATONIA—But a single species of this genus, Eatonia Pennsylvanica is of any value for grazing purposes. This grass is found in abundance in

Nolding Fescue—Festuca nutans.

Middle Tennessee and in moist, open places on the borders of woods in all parts of the state. It is a valuable addition to the native grasses and cattle seem to relish it more than any other wild grass. A species known as Eatonia filiformis grows on the dry hills of the cretaceous formation in West Tennessee, but while cattle will eat it in the absence of other grasses it is not of much agricultural value.

Diarrhena Americana (American Diarrhena) is found growing on the rich soils among limestone rocks. Its feeding value is about equal to that of cheat.

Eleusine Indica (yard grass: dog's tail) is frequent in all places where there are human habitations or have been. In many abandoned places on the Highland Rim it grows very rank. It constitutes one of

Eatonia Pennsylvanica.

the wild pasture grasses that will make good and lasting pickings for all kinds of stock.

Bouteloua curtipendula (horse shoe grass) grows on dry soils and in pine barrens in various parts of the State. It makes a dense turf which will bear tramping well. It is one of the best native grasses for highway pastures among cedar glades.

Muhlenbergia diffusa (nimble will) is an indigenous and perennial grass. It forms a dense mat on limestone soils and in river bottoms. The writer has seen it growing in the woods four and a half feet high. There is a great difference of opinion as to its feeding value. Dr. F. H. Gordon maintained that it was one of the most nutritious of the wild grasses and said that this was demonstrated by the fact that much of the beef and mutton sold in the Nashville and Memphis markets was fattened on nimble will. On limestone lands thinly wooded and where blue grass has not already obtained possession, nimble will furnishes good pasturage for five or six months in the year. Dr. Gattinger, on the con-

trary, thinks all species of the Muhlenbergia make very poor forage and are not eaten by stock unless they are compelled to do so by the absence of more nutritious grasses. The writer is inclined to think that the quality of this grass is affected by the soil upon which it grows.

Mexican Muhlenbergia is another species that is highly commended by some writers. Dr. C. E. Bessey, of Nebraska, says this grass has been known in the West for many years as a valuable one. "Chemical analyses," he continues, "show that Muhlenberg grass is highly nutritious. In the years 1878 and 1879, at my suggestion, Mr.W.K.Robinson, a graduate of the Iowa Agricultural College, made analyses of this grass, with results which showed that in nutritiousness it ranked with red top and

Nimble Will—Muhlenbergia diffusa.

blue grass, and, in some instances, timothy. More recent analyses by the government chemist at Washington make a still better showing. Taking an average of the analyses I find the following results:

"Timothy contains 4 1-3 per cent. of albuminoids.

"Orchard grass contains 6 1-2 per cent. of albuminoids.

"Red top contains 6 2-3 per cent. of albuminoids.

"Blue grass contains 8 per cent. of albuminoids.

"Muhlenberg grass contains 17 2-5 per cent. of albuminoids.

"That is, Muhlenberg grass is more than twice as nutritious, weight for weight, as blue grass. It is nearly three times as nutritious as red top and orchard grass, and about four times as nutritious as timothy. Now I would not for a moment be understood as considering these analyses as settling the relative merits of these grasses. It is well known, however, that the analysis of a grass is one of the important factors in determining its value, and I bring it in here as simply corroborating what the feeders of hay have been saying for a long time."

There are four or five species of this grass found growing on wooded lands in Tennessee. All of them remain green until winter. In their

general appearance they resemble small cane from the hardness and enamelled surface of the stalks and the stiff aspect of the leaves. They furnish pickings to stock until December. Their creeping rootstocks are very troublesome on cultivated grounds, especially on newly opened bottom lands and much resemble those of Bermuda grass.

Sporobolus Indicus (drop seed grass) is said to be a good grass in wild pastures. It is soft and succulent, springs up quickly after being grazed and will last from May until October. It usually grows in patches and in low and small tufts. It is very palatable to cattle. In the West several species of Sporobolus furnish good winter pastures. Sporobolus asper is another species found in Tennessee and grows mainly on the Cumberland table-land on sandy soils and in the oak barrens of the High-

Muhlenbergia Mexicana.

land Rim on siliceous soils. It forms one of the least nutritious wild grasses in the highway pastures of these regions.

Zizania aquatica (water or Indian rice grass) is found in the swampy regions of West Tennessee. It has flat leaves two to three feet long and its culms grow to the height of three to nine feet. It is found in swamps and on the borders of sluggish streams. In some pastures of the west the seed is gathered by the Indians and made into a species of mush or bread which they relish greatly. Cattle are fond of the herbage and Dr. Gattinger states that in its feeding value an acre of it is equal to an acre of wheat. The seed is eaten by red birds.

The foregoing, with the grasses described in Part I constitute the principal economic true grasses in the State. A few of the domesticated grasses have been found growing in the wild pastures. Among the most valuable of these are the Randall grass (Festuca elatior); meadow oat or evergreen grass (Arrhenatherum elatius); Tennessee fescue (Festuca rubra glaucescens); various species of Paspalum and Panicum; blue grass (Poa pratensis); annual spear grass (Poa annua); English blue grass

(Poa compressa) and other species of Poa. All these are found intermingled with the wild indigenous grasses to a greater or less extent in the highway pastures of the State. The beard grasses (Andropogons) form by far the largest number of grasses that occur in the natural pastures on the Cumberland table-land and on the Highland Rim.

WILD LEGUMINOUS AND OTHER FORAGE PLANTS FOUND IN THE HIGHWAY PASTURES OF TENNESSEE.

There are many species of wild vetches, beans, peas and nuts, and several grazing plants belonging to the leguminous family that are found in the highway pastures and woods and in old fields, fence corners and waste places that furnish forage, seeds and nuts highly nutritious for stock. The wild vetches are especially abundant. Among the most valuable are the small flowered vetch (Vicia micrantha), Carolina vetch

Drop Seed Grass—Sporobolus Indicus.

(Vicia Caroliniana), American vetch (Vicia Americana), Tennessee milk vetch (Astragalus Tennessiensis), Canada milk vetch (Vicia Canadensis). These vetches are found in most of the highway pastures of the State, sometimes abundant, sometimes scarce, adapting themselves to the character of the soil, some preferring a limestone soil, others a sandy soil. Some of these make excellent food for cattle, sheep and hogs.

The pencil flower (Stylosanthes elatior) is found on the sandy soils throughout the State. It is a lowly herb, growing in tufts and the stems are downy on one side. It has an orange yellow flower. Cattle are very fond of it.

Bush clover (Lespedeza). There are six or eight species of this genus known to grow in Tennessee. The Lespedeza repens, Lespedeza

Stuvei, Lespedeza capitata, Lespedeza violacea, Lespedeza hirta and Lespedeza striata or Japan clover, are all valuable grazing plants. The last named is an introduced plant and has been treated at length in another place. It is believed that the indigenous varieties found in America are equally as valuable, though probably lacking in the diffusive qualities of Japan clover. All the native species are found growing on dry soils and in barrens, though they are not averse to good soils.

Tick trefoil, beggar's ticks, beggar's lice. There are sixteen species of tick trefoil growing for the most part on uplands and siliceous and sandy soils of the State, though a few cling to the limestone soils and to rich woods. These furnish a large bulk of the pea vine forage found in uncultivated regions. They enrich the herbage of all the natural pasture lands of Tennessee.

The wild "clovers" are numerous and nutritious. Among the best are several species of the Petalostemon and the Trifolium genera. Leafy prairie clover (Petalostemon foliosus), Buffalo clover (Trifolium reflexum), white clover (Trifolium repens), and black medick (Medicago lupulina) are all valuable forage plants.

The Psoraleas supply good food for cattle. This genus prefers uplands and open piney woods. Psoraleas melilotoides, for instance, is quite abundant in the open, sandy woods of the southern counties of West Tennessee. It is a vigorous perennial with stout, deeply growing roots.

Ground nut or wild bean (Apios tuberosa) grows wild in the woods in various parts of the State, generally in low grounds. It has subterranean shoots bearing tubers which are greatly sought after by swine. It grows with a climbing vine and its flowers are a brownish purple with a faint odor of the violet. It bears legumes from three to five inches long which contain from eight to ten seeds. Dr. Gattinger thinks this is one of the wild leguminous plants that ought to be introduced into cultivation.

The wild kidney bean (Phaseolus perennis) is a very common plant in every part of Tennessee. It grows in woody places. It has slender climbing stems and scimitar-shaped drooping pods with four or five seed each. It forms one of the valuable wild beans of the wooded pastures. Another species of this same family is the long stalk kidney bean (Phaseolus helvolus) which grows on sandy soils. The stalks are several times larger than the leaves. One single plant makes a large quantity of herbage for stock.

Still another member of this family is the creeping kidney bean (Phaseolus diversifolius) which grows in the cedar glades with a prostrate spreading stem and supplies valuable forage for hogs, sheep and cattle.

There are several wild peas that are held in high esteem by those who depend during the summer and fall months upon the woodland pastures for carrying their stock. The best are: The Virginia butterfly pea (Centrosema Virginianum), the milk pea (Galactia mollis), the smooth milk pea (Galactia glabella), and the butterfly pea (Clitoria Mariana). All these produce foliage and fruit that are eaten by cattle.

The hog peanut (Amphicarpaea monoica) grows on rich soils and is a common plant in the wooded lands around Nashville. The herbage is good for cattle and the subterranean nuts for hogs.

Several sensitive plants grow in the woods on dry or siliceous soils in every part of the State, and are eaten by all kinds of herbivorous animals. The best of these are the Desmanthus brachylobus, the Schrankia uncinata and the Schrankia angustata, the two latter being creeping briars.

Besides the leguminous plants herein mentioned as furnishing, in highway pastures, sustaining food for domestic animals, beggar's lice (Cynoglossum Morisoni) may be added. This belongs to the borage and not to the leguminous family. It grows in fields and woods and the ripened fruit, which consists of convexed-barbed, flat nutlets slightly joined together, is greedily eaten by cattle. These nuts ripen about the time of the first autumnal frosts and are highly nutritious. Cattle often fatten upon them during the latter months of the year.

For the raising of swine the pasture lands of the mountain districts offer unusual advantages, for, besides the nutritious grasses and leguminous plants there are succulent and aromatic roots in which these animals delight. There is also an abundance of mast, which supplies food for cattle as well as hogs from early fall through the winter until the grasses and forage plants spring up with the warmth of the season. The mast is both bitter and sweet. The bitter mast is composed of the acorns of the oak trees; the sweet mast is composed of the nuts of the beech, hickory, chestnut and walnut trees and hazel bushes. Persimmon, haw, pawpaw, huckleberry, blackberry, dewberry, mulberry, service berry, wild grapes and other fruits and berries are greedily devoured by hogs. Thousands of head of these animals are kept fat throughout the entire year by the food which they get from natural pastures.

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